WILLS WING

Fusion 141 and 150

Owner / Service Manual

October 15, 1998 - Third Edition

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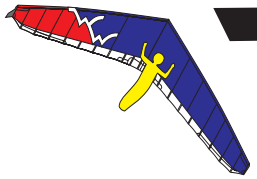


WILLS WING

World Record Hang Gliders Since 1973 • Orange, California USA

Glider Delivery Check List

PO #	Model / Size	Serial #	Date
Customer Name		Phone #	
Address	City	State	Zip
Dealership Name	Order Date	Date Delivered	

Dealer Test Flight Results

Pilot	Site	Date Tested	Airtime
Test Flight Comments			

Dealer/ Customer Checklist	Customer	Dealer
Reviewed glider owner's manual with customer	☐	☐
Reviewed set-up, break-down, and pre-flight procedures	☐	☐
Reviewed maintenance and service procedures	☐	☐
Reviewed car top mounting (HG), Trunk heat cautions (PG)	☐	☐
Delivered customer response form	☐	☐
Delivered glider parts kit	☐	☐
Delivered owner's manual	☐	☐

READ BEFORE FLIGHT

CAUTION: Use of this equipment may result in INJURY OR DEATH. Please be sure you are qualified to fly this product, are thoroughly familiar with and follow all proper procedures as explained in the owner's manual. You are reminded that YOU FLY AT YOUR OWN RISK.

I have read and understood all of the above and hereby release Wills Wing Inc., its employees, and dealers acting in association with or on behalf of Wills Wing Inc. from all liability in connection with my use of this glider.

Customer Signature Dealer Signature

Introduction

Thank you for purchasing a Wills Wing glider, and welcome to the world wide family of Wills Wing pilots. We are a company of pilots and aviation enthusiasts, and our goal is to serve your flying needs now and in the future, as we have done for pilots throughout the world since 1973.

We encourage you to read this manual thoroughly for information on the proper use and maintenance of your Wills Wing glider. If at any time you have questions about your glider, or about any aspect of hang gliding that your Wills Wing dealer cannot answer, please feel free to give us a call.

If you have access to the Internet, please visit us regularly at http://www.willswing.com. The site features extensive information about Wills Wing gliders and products, a Wills Wing Dealer directory, a comprehensive list of service and technical bulletins, the latest editions of owners manuals, our complete retail price list, a search engine, e-mail and more.

The most important contents of our internet site are the service and technical bulletins, and the latest editions of owners manuals. This is your single best source for safety and airworthiness advisories on Wills Wing products. Many of the documents are published in Adobe Acrobat format. A free viewer for Acrobat files is available at http://www.adobe.com.

We wish you a safe and enjoyable flying career, and, once again, welcome aboard!

Rob Kells, Mike Meier, Linda Meier, and Steve Pearson

Wills Wing, Inc.

Disclaimer and Warning

Hang gliding is a form of aviation. Like any form of aviation, its safe practice demands the consistent exercise of pilot skill, knowledge of airmanship and weather, judgment and attention at a level which is appropriate to the demands of each individual situation. Pilots who do not possess or exercise the required knowledge, skills and judgment are frequently injured and killed. The statistical rate at which fatalities occur in hang gliding is approximately one per thousand participants per year.

The Federal Aviation Administration does not require a pilot's license to operate a hang glider. Hang gliders and hang gliding equipment are not designed, manufactured, tested or certified to any state or federal government airworthiness standards or requirements. Federal Aviation Regulation Part 103 states in part, "ultralight vehicles are not required meet the airworthiness certification standards specified for aircraft or to have certificates of airworthiness" and "operators of ultralight vehicles are not required to meet any aeronautical knowledge, age, or experience requirements to operate those vehicles or to have airman or medical certificates." Wills Wing hang gliding products are not covered by product liability insurance. As a hang glider pilot, you are entirely responsible for your own safety. You should never attempt to fly a hang glider without having received competent instruction. We strongly recommend that you not participate in hang gliding unless you recognize fully and wish to personally assume all of the associated risks.

Please fly safely.

Technical Information and Placarded Operating Limitations

The Fusion 141 and 150 have been tested and found to comply with the Hang Glider Manufacturers Association (HGMA) Airworthiness Standards. These standards require:

1. A positive load test at root stall angle of attack at a speed equal to at least the greatest of:
    a. 141% of the placarded maximum maneuvering speed
    b. 141% of the placarded maximum rough air speed
    c. 123% of the placarded speed never to exceed

    for at least three seconds without failure.

    The required speed for the Fusion for this test was 65 m.p.h..

2. A negative 30 degree angle of attack load test at a speed equal to at least the greatest of:
    a. 100% of the placarded maximum maneuvering speed
    b. 100% of the placarded maximum rough air speed
    c. 87% of the placarded speed never to exceed

    for at least 3 seconds without failure.

    The required speed for the Fusion for this test was 46 m.p.h..

3. A negative 150 degree angle of attack load test at a speed equal to at least the greater of 30 m.p.h. or 50% of the required positive load test speed for at least 3 seconds without failure.

    The required speed for the Fusion for this test was 32 m.p.h..

4. For the Fusion with a Vne of 53 m.p.h., pitch tests at speeds of 20 m.p.h., 37 m.p.h. and 53 m.p.h. which show the glider to be stable over a range of angles of attack from trim angle to 20 degrees below zero lift angle at 20 m.p.h., and from trim angle to 10 degrees below zero lift angle at 37 m.p.h., and from 10 degrees above zero lift angle to zero lift angle at 53 m.p.h..

5. Flight maneuvers which show the glider to be adequately stable and controllable throughout the normal range of operation.

Note: The Fusion has been designed for foot launched soaring flight. It has not been designed to be motorized, tethered, or towed. It can be towed successfully using proper procedures. Pilots wishing to tow should be USHGA skill rated for towing, and should avail themselves of all available information on the most current proper and safe towing procedures. Suggested sources for towing information include the United States Hang Gliding Association and the manufacturer of the towing winch / or equipment being used. Wills Wing makes no warranty of the suitability of the glider for towing.

Because of the lack of a kingpost and top rigging on the Fusion design, tethering the glider by the nose, such as is commonly done during platform towing operations, creates the potential for overloading the keel tube of the glider which could result in a structural failure. To avoid overloading the keel, any tether line attached to the nose should pull as much as possible in line with the keel, and in no case in a direction more than 45 degrees below the line of the keel tube itself. Please read the section on towing.

Flight operation of the Fusion should be limited to non aerobatic maneuvers; those in which the pitch angle will not exceed 30 degrees nose up or nose down from the horizon, and the bank angle will not exceed 60 degrees. The Fusion is generally resistant to spinning, but may spin from a stalled turn, especially if the VG is adjusted at or near the tight end of the range, and the rate of application of pitch is moderately rapid. The Fusion can be induced to spin at any VG setting. Recovery from a spin requires unstalling of the wing, and it is therefore critically important that in the event of a spin, no application of nose up pitch control be held. The Fusion will recover from a spin once control pressures are relaxed. As the nose lowers and the angle of attack is reduced, the stall will be broken and the spin will stop. However, such recovery will consume significant altitude, and will result in the glider assuming an unpredictable heading. Recovery from a spin may therefore involve a flight trajectory which intersects the terrain at a high rate of speed. An aggravated spin could result in loss of control, in flight inversion, and structural failure. Therefore no attempt should ever be made to deliberately spin the glider. The Fusion provides the pilot with a high degree of pitch authority, in combination with a very low twist sail. As a result, it is possible by pushing fully out on the bar to produce a very aggravated and severe stall, the recovery from which may involve very severe pitch down rotation, the pilot going weightless, and the glider recovering via an unpredictable trajectory with a significant altitude loss. Therefore, full arms extension aggravated stalls should not be induced except on landing flare.

The maximum steady state speed for a prone pilot in the middle of the recommended weight range full forward on the control bar with the VG set full tight is approximately 58 m.p.h. for the Fusion. The placarded speed never to exceed for the Fusion is 53 m.p.h. An airspeed indicator is provided with the Fusion and should be used by the pilot as an aid to comply with the placarded limitations.

The placarded maximum maneuvering speed, and the placarded maximum rough air speed of the Fusion are each 46 m.p.h. This speed will be achieved with the control bar basetube approximately at the waist. This speed should not be exceeded in anything other than smooth air. No abrupt maneuvering or control inputs should be made at anything above this speed.

The stability, controllability, and structural strength of a properly maintained Fusion have been determined to be adequate for safe operation when the glider is operated within all of the manufacturer specified limitations. No warranty of adequate stability, controllability, or structural strength is made or implied for operation outside of these limitations.

The stall speed of the Fusion at maximum recommended wing loading is 25 m.p.h. or less. The top (steady state) speed at minimum recommended wing loading for a prone pilot with a properly designed and adjusted harness is at least 45 m.p.h.. All speeds given above are indicated airspeeds, for a properly calibrated airspeed indicator mounted in the vicinity of the pilot. Wills Wing provides such an airspeed indicator with the glider. It is strongly recommended that the pilot fly with such an airspeed indicator. Refer to the section on using the airspeed indicator for further information on speeds to fly.

The recommended hook in pilot weight range for the Fusion is:

Fusion 150: 150 - 275 lbs.
Fusion 141: 135 - 235 lbs.

Be advised that pilots with hook in weights of less than 20 lbs above minimum will find the Fusion more demanding of pilot skill to fly, and that pilots hooking in within 20 lbs of the maximum will experience some relative degradation of optimum sink rate performance due to their higher wing loading.

A minimum USHGA Advanced (IV) level of pilot proficiency is required to fly the Fusion safely. Pilots are advised that the optimum proficiency level for the Fusion is higher than the minimum recommended. Operation of the glider by unqualified or under qualified pilots may be dangerous.

Operating the Fusion outside of the above limitations may result in injury and death. Flying the Fusion in the presence of strong or gusty winds, or turbulence may result in loss of control of the glider which may lead to injury and death. Do not fly in such conditions unless you realize and wish to personally assume the associated risks. Wills Wing is well aware that pilots have, and continue to perform maneuvers and fly in conditions which are outside the recommended operating limitations stated herein. Please be aware that the fact that some pilots have exceeded these limitations in the past without dangerous incident does not imply or insure that the limitations may be exceeded without risk. We do know that gliders which meet all current industry standards for airworthiness can and do suffer in flight structural failures, both as a result of turbulence, and as a result of various maneuvers outside the placarded operating limitations, including, but not necessarily limited to aerobatics. We do not know, and cannot know, the full range of maneuvers or conditions which may cause the pilot's safety to be compromised, nor can we test the glider in all possible circumstances.

FUSION MANUAL ADDENDUM

There have been several design improvements made to late model Fusions. Please take a moment to note the following changes before setting up or flying your new Fusion.

Leading Edge Pocket / Mylar Insert

The mylar pocket has been changed to make the removal of the mylar insert easier. On new style Fusions the mylar pocket is open to the front so the mylar can be removed without disassembling the glider.

Nosecone Installation

The new style nose cone has no velcro on the back edge. To install the nosecone slide the top rear edges between the mylar pocket and mylar insert. Work it back into position flush with the back edge of the mylar pocket, and then velcro the lower edge into place on the bottom surface. It takes a bit of practice to get it installed cleanly, but you will notice there is no bump caused by the velcro at the back edge.

Transverse Batten Installation

The transverse battens (54 inches long with black heat shrink on the outside) go inside the bottom surface at the back between the #3 batten (second shortest curved batten) and the #5 batten (fourth shortest curved batten). The transverse batten does not need to be removed unless the rear leading edges are removed to "short pack" the glider for transport. Please refer to page 6 in this manual for more information on this.

The new style Fusion sail does not have a batten pocket to hold the transverse batten. The "sprog" (internal washout strut) supports the transverse batten below the #4 batten.

To install the transverse batten slide the end of the batten through the webbing receptacle just inboard of the #3 batten, and then slide it through the webbing receptacle at the #5 rib. Put tension on the batten towards the #5 rib and firmly close the velcro at the #3 receptacle to keep the transverse batten in place.The transverse batten is tapered at each end. The longest (flat) side of the batten goes down towards the bottom surface. The newest Fusion transverse battens are labeled "TOP" on the short side.

Button Lock Apex Slider

Newer Fusions are equipped with a spring loaded control bar apex slider lock. An illustration of the new assembly is included in the assembly diagrams. This new system is much easier to release and engage than the clevis pin and safety ring on earlier models.

Fusion Breakdown Procedure for Shipping, and Reassembly Procedure

The front leading edge is 60mm (2.36") oversleeved with 62mm (2.44") at the crossbar junction. The rear leading edge is 50mm (1.97") oversleeved with 52mm (2.05") at the front end. There are two fittings attached to the front end of the rear leading edge to provide the proper fit and orientation in the front leading edge. The front fitting is slotted and engages in a clevis pin though the front leading edge.

To break down the leading edges follow these steps

1. Lay the glider on the ground or floor, unzip and remove the bag and remove the velcro ties. Undo the velcros which hold the sail around the sail mount plug. Pull the sail rearward at each tip to dismount the sail from the rear leading edge.
2. Unzip the sprog access zipper in the bottom surface and disconnect the sprog bungee from the sprog rear end paddle.
3. Obtain an indelible marker. Mark the rear leading edges left and right (remember that left and right are reversed if the glider is lying "on its back", upside down).
4. Pull the rear leading edge straight aft to disengage it from the front. Slide it forward inside the sail until you can fold the sprog past the internal sail ribs, then remove the whole assembly from the from the sail. Be very careful not to damage the sail with the hardware attached to the rear leading edge. Tape or pad the edges of the front end of the rear leading edge tubes, and the rear of the front leading edge tubes to prevent sail damage during transit.
5. Remove the carbon sandwich transverse batten from the sail by opening the velcro closure at the #3 batten end of the transverse batten pocket and sliding the transverse batten out towards the wing tip. Note that the orientation of the transverse batten is flat side closest to the bottom surface.

   Be careful handling the transverse batten - carbon fiber splinters can be very dangerous.

   Wrap and pad the transverse batten for shipment.
6. Carefully fold the rear of the sail over against the front, and replace the bag on the glider.

Remounting the rear leading edges

1. Install the transverse battens in the batten pockets. *The proper orientation for the transverse batten is with the flat carbon side (bottom side) of the batten facing the bottom surface of the sail.* The top side of the batten should lay flat in the pocket against the top surface of the sail. Secure the velcro closure.

2. Make sure you are mounting the correct leading edge rear into the correct front (check the "right" / "left" designation).

3. Slide the rear leading edge (through the sail past the edge of the front leading edge) far enough to feed the sprog out through the curved bottom surface access zipper between the sail ribs on battens no. 3 and no. 4. Engage the rear leading edge into the front. If the rear leading edge is properly installed, the black plastic crescent adapter that is attached to the rear leading edge will be completely inside the front leading edge. (Note: On early serial production gliders the black crescent may protrude 1/8" from the front leading edge when the rear leading edge is fully engaged.)

4. Remount the sail to the rear leading edge, making sure to align the sail mount webbing squarely in the slot and attach the securing velcros.

   The sail is mounted to the leading edge by the inner (forward) of the two loops of webbing. The outer loop is a pull handle only.

   You may find it helpful to use a large, flat bladed screw driver to pry the sail mount webbing over the end of the leading edge tube and into the slot. Take care not to damage the webbing.

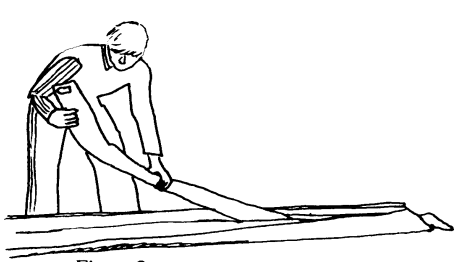
5. Attach the sprog bungee to the sprog paddle. One end of the bungee is secured to a tab sew to the sail body. Insert the free end of the bungee though the hole in the corresponding side of the paddle, tie an overhand knot and push it back into the channel in the bottom of the paddle.

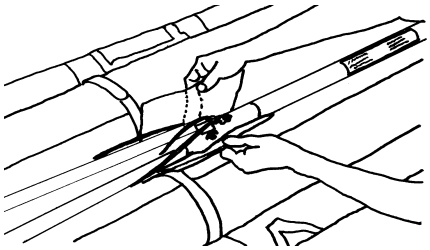
Fusion Set-Up Procedure

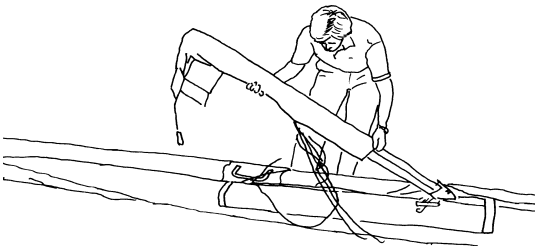
The Fusion has been specially designed to set up quickly and easily either on the control bar or flat on the ground. We will first cover the steps for setting up on the control bar.

1. Lay the glider on the ground, with the bag zipper up, with the nose into the wind.

2. Undo the zipper, remove the battens, remove the protective pad at the rear wire station on the keel, and remove the control bar bag. Newer gliders may have a pair of neoprene protective socks over the rear wire junction and the end of the keel instead of a pad.







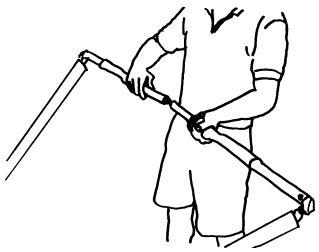
3. Unfold the control bar legs.

    a. If the glider is equipped with a folding basetube:

        i. Straighten the fold in the folding basetube.

        ii. Preflight the folding basetube center hardware at this time, checking that the nuts and coil spring pins are secure, and that the tangs are straight and in good condition.

        iii. Slide the basetube center sleeve over the center joint until it is positioned between the button spring pins. (Note: If you plan to clamp instruments to the basetube center, position the center sleeve so that one button passes through the hole near one end of the sleeve, which will secure the sleeve against rotation.)



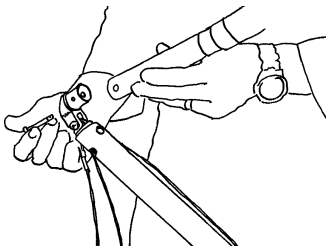
b. If the glider is equipped with a non folding basetube:

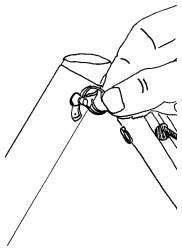
i. Remove the safety ring, wing nut and bolt from the corner bracket.

ii. Insert the corner bracket all the way into the basetube.

iii. Install the bolt, wingnut and safety, securing the bracket to the basetube.

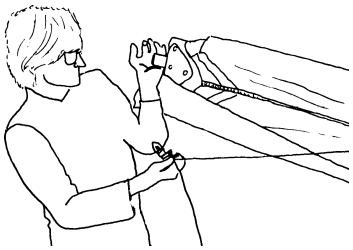
Make sure that the aluminum fitting is fully inserted into the basetube, and that the bolt is through both the basetube and the fitting. If the hole in the fitting can be seen outside the end of the basetube, the fitting is not fully installed, and will likely disengage in flight resulting in a dangerous structural collapse and loss of control of the glider.

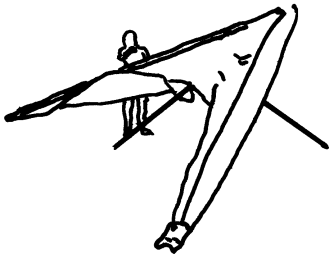




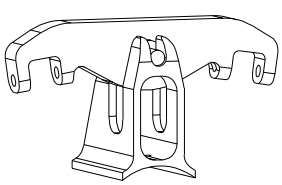
Do not insert the fitting at an angle, and do not force the fitting into the basetube if it does not slide in freely. Check for dirt or damage to the fitting or the inside of the basetube. If the fitting is forced into the basetube, it may be impossible to remove. See your dealer if the fitting becomes difficult to install or remove.

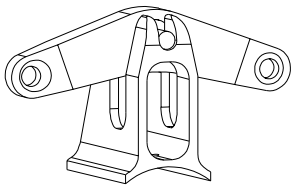
4. Flip the glider upright on the control bar, and remove the bag and all the velcro ties. Do not remove the leading edge tip protector bags at this time, but do loosen the velcros on the tip bags. If there is more than eight m.p.h. of wind, or if the wind is gusty, turn the glider 90 degrees to the wind direction. Spread the wings almost all the way.





5. Install the elevated hang system spreader bar onto the base pillar. Check for free pivoting movement of the spreader bar, and that the pivot pin is securely installed in the slot in the base pillar.

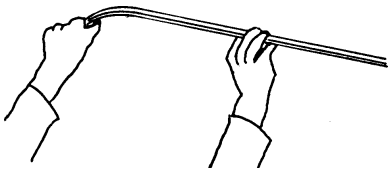




Webbing Hang System Perlon Hang System

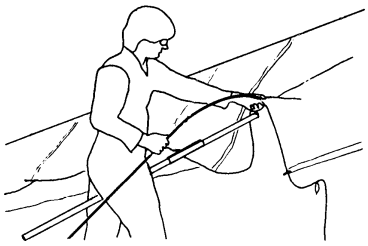
6. At this time, undo the velcro attachment of the two halves of the front keel pocket. This is to allow the xbar center wedge and its rear webbing hold down strap to slide freely aft on the keel when you tension the crossbar.

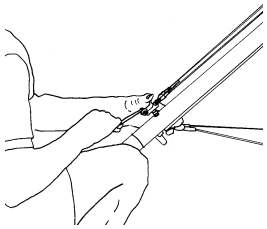
7. Remove the battens from the batten bag, and check each batten for symmetry against the corresponding batten from the other wing. Wills Wing convention is that black tipped battens go in the right wing and white tipped battens in the left, except for the straight #1 plug on battens which all have black tips.



8. Install the cambered top surface battens in the sail, leaving out the shortest two on each side (#2 and #3) for now. Each batten is secured by a double loop of the batten string. Order of insertion is longest to shortest, from the root out. When inserting the inboard most battens, lift the keel to ease the insertion. The longest battens may catch the edge of the mylar insert at the front of the sail. If that happens, make sure that the mylar insert is not creased or folded in the pocket. When these battens reach the back side of the leading edge tube, it may be necessary to lift the sail along the batten pocket to facilitate insertion of the batten all the way.

Insert the battens carefully, so as to minimize stress and wear on the sail. Never insert or remove top surface battens with the crossbar tensioned (except for up to the last four on each side) and never insert or remove battens with heavy wind pressure on the top of the sail or in any condition which causes the battens to slide with great resistance in the pockets.





9. Spread the wings all the way and check all cables for any twisted thimbles or tangled cables.

10. At the rear of the keel, tension the crossbar and secure the crossbar sweep wire by pulling the keyhole channel aft along the keel until the large hole lines up with the keyhole bolt. Lower the keyhole bracket over the bolt until the channel can slide forward so that the narrow part of the keyhole slot is fully captive in the narrow part of the bolt collar.

Never install the keyhole channel onto the keyhole bolt without making absolutely sure that the channel is fully engaged on the narrow neck of the bolt, and tensioned forward into the fully locked position. An in-flight disengagement of this attachment will cause a complete loss of structural support of the glider and a total loss of control.

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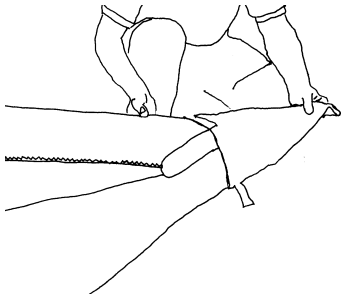
11. Overlap the mating velcro surfaces of the front keel pocket around the bottom of the keel tube and secure them together. The VG activation rope should be inside the keel pocket.

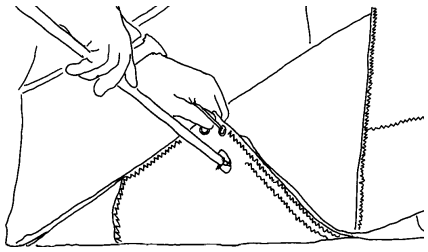
12. Remove the wingtip protector bags. Install the last two curved battens on each side.

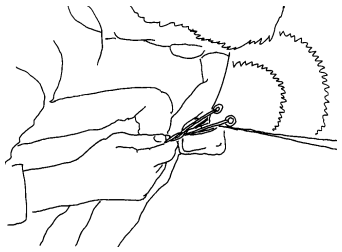


13. Reach in through the end of the sail at the tip, grasp the floating washout tube and align it for insertion into the washout tube sleeve. Make sure when inserting it that the washout tube slides all the way home into the sleeve. It helps to lift the end of the #2 batten. Check the washout tube to make sure it is secure and free to float up and down.

14. Install the plug-on #1 battens by inserting one end through the hole in the bottom surface at the tip and engaging the forked batten tip on the clevis pin standoff on the top of the leading edge tube. The #1 batten should bear on the top side of the washout tube. Secure with a double loop of the 505 batten string. The proper #1 tension for the Fusion is very tight and it is easiest to install the batten string if you first set the VG to the full tight position.

Be sure to re-set the VG to the desired setting prior to launch.





15. At this time preflight the following from the open end of the wingtip:

    a. The sail mount webbing - make sure that the sail is mounted by the inner loop of webbing, and that the webbing is laying flat in the bottom of the slot in the sail mount endcap.

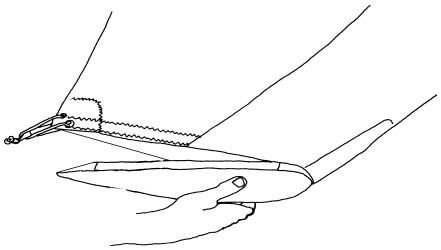
    b. The number one batten clevis pin and safety.

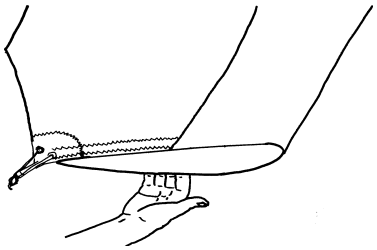
    c. The washout tube installation.

    d. That the internal rib in the #2 batten is zipped.

16. Install the plastic wing tip fairing, or the optional winglet. Make sure that the fairing or winglet is fully inserted into the leading edge such that the velcro mates securely around the entire perimeter. While installing the tip fairing or winglet, support the aft tip of the number one batten as necessary

so as to equalize the tension around the perimeter of the open end of the sail at the wing tip to insure that the sail mates properly to the tip fairing or winglet.





17. Open the V shaped access zipper in the outboard section of the bottom surface. Swing the sprog back and outwards, until the rear sprog paddle is aligned underneath the transverse batten in the top surface sail pocket just forward of the rear of the bottom surface. Attach the clip in the sail to the ring or loop on the sprog paddle to secure the sprog in position. Check the sprog for freedom of upward motion and that it is securely restrained at the downward limit by the sprog cable. Check the cable and the associated attachment fittings. The neoprene cover at the center of the sprog can be slid aft to inspect the cable attachment at this point. Early model Fusions have an opposing bungee to lightly tension the sprog retaining clip. The bungee is unnecessary because the sail rib effectively prevents the sprog from rotating inboard.

18. While in this area, check the internal rib zipper for the rib adjacent to the sprog. Also, from this point you can visually inspect the cam lever plate, support strap, cable attachment and bolts, nuts and safeties at the crossbar / leading edge junction. When finished, zip up the sprog access zipper.

Before attempting to install the bottom nose wires be sure that the control bar apex is pushed into place fully aft on the slider track.

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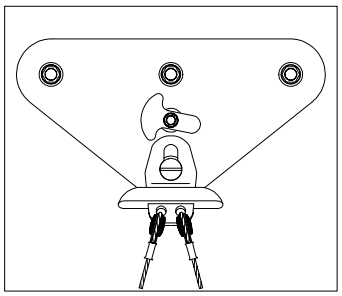
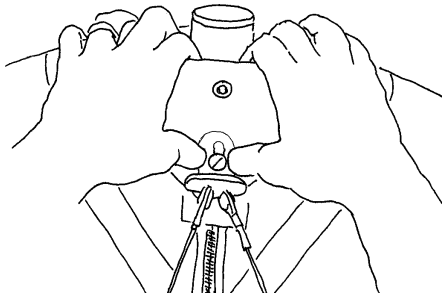
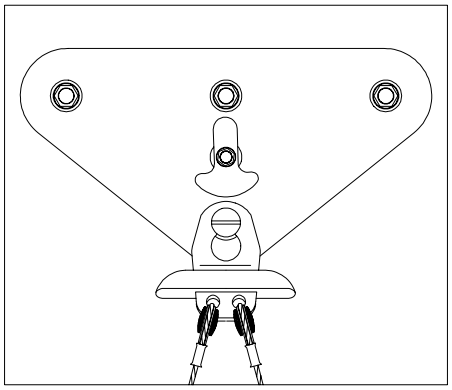
19. Attach the bottom front wires to the bottom of the nose. In order to attach or remove the keyhole tang from the collared bolt, the aluminum anchor lock must be rotated into the position shown below, left. Once this is done, install the keyhole tang over the collared bolt by pulling down on the nose of the glider while pressing the tang upwards over the collared bolt. Remember, it is the pulling down of the glider's nose rather than the upward pressure on the tang that allows you to install the tang over the bolt.

    If you have difficulty installing the tang, the apex is fully aft, and no wires are twisted or thimbles cocked, it is probably because the glider is not sitting on level ground.





After installing the keyhole tang, rotate the aluminum anchor lock as shown to secure the tang on the bolt.



Because of the lack of a kingpost and top rigging on the Fusion design, tethering the glider by the nose, such as is sometimes done after setup and while waiting to fly, creates the potential for overloading the keel tube of the glider which could result in a structural failure. A similar problem could arise during a hang check. To avoid overloading the keel, any tether line attached to the nose, or any restraint used during a hang check should pull as much as possible in line with the keel, and in no case in a direction more than 45 degrees below the line of the keel tube itself. See the diagram in the section on towing. Alternately, for performing a hang check, the glider can be supported by pushing up from underneath the rear keel instead of pulling down and forward at the nose.

Make sure the anchor lock is installed properly. There is not as much tension in the bottom wires to keep the keyhole tang engaged as with gliders with top rigging.

20. By lifting up and back on the nose batten strings, push the nose battens fully back into the sail so that the tips rest on top of the noseplate.
21. Install the nosecone taking care to align it so that it lies flat on the top and bottom of the sail.

22. Install the bottom surface battens.
23. Conduct a complete preflight of the glider, checking all assemblies which have not already been checked.

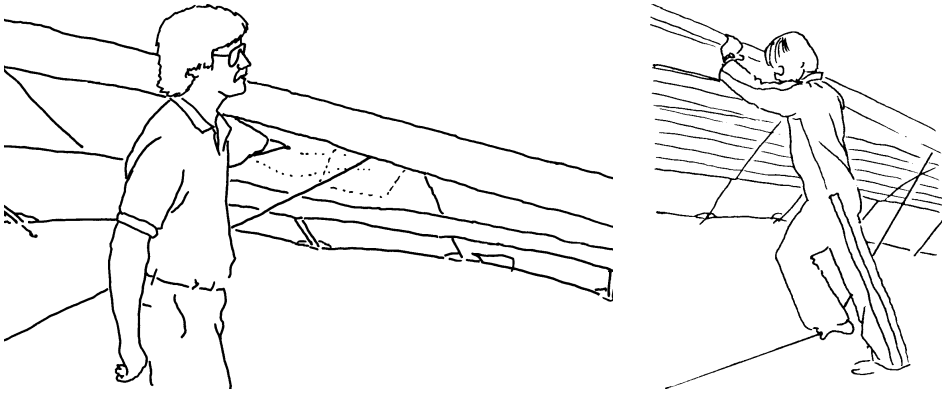
Preflight Procedure

Along the left leading edge

Carefully check the entire length of the leading edge pocket to insure that the mylar insert is lying flat in the pocket. If any section of the mylar is folded under, de-tension the crossbar, remove the batten closest to the area of distortion, and unfold the mylar.

Failure to correct folded under or severely creased mylar will cause a severe alteration of the flight characteristics of the glider which may lead to a dangerous loss of control.

While pushing up on the leading edge between the nose and the crossbar junction, step on the bottom side wire with about 50 lbs. of force. This is a rough field test of the structural security of the side wire loop, the control bar and the crossbar, and may reveal a major structural defect that could cause an in-flight failure in normal operation.



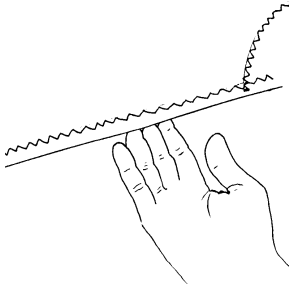
Open the crossbar junction access zipper and look inside, making sure that the bottom side wires are properly secured to the crossbar and that the nut and safety ring are in place. Check the attachment of the cam lever plate to the crossbar and leading edge, the attachment of the support strap, and VG activation cable. The neoprene protector can be slid back to check the cable attachment. Re-close the zipper.

At the left wingtip

You have already preflighted those parts of the glider accessible only with the tip fairing removed. At this time, check the tip again for secure and proper installation.

Along the trailing edge, left wing

Check that there are no tears in the sail material along the trailing edge.



Check that all batten strings are properly secured.

Check that the sprog is properly secured in position supporting the transverse batten, and that the sprog access zipper is properly closed.

From the rear keel

Check again that the keyhole channel is fully engaged and locked to the keyhole bolt. *Also check that the sweep wires are tight and actively tensioning the channel on the bolt.*

Along the trailing edge, right wing

Same as for left wing.

At the right tip

Same as for left tip.

Along the right leading edge

Same as for left leading edge.

Under the glider at the control bar

Sight down the downtubes, making sure that they are straight.

Unzip the center zipper.

Check the sweep wires for wear where the pass through the hang system pillar and where they pass over the keel mounted VG pulley bracket.

Check the cables at the control bar corners, making sure there are no kinks or twisted thimbles. Check for proper installation of all nuts and safety rings at the control bar corners.

Check that the hang system spreader bar is properly oriented (ends lower than center pivot), is fully engaged on the pillar and is free to pivot. Check that the back up hang loop is secured to the keel behind the base for the elevated hang system.

Check the control bar base bracket pulley for free rotation. Overtightening of the mounting bolts will cause this pulley to bind. Check the routing of the VG rope around the keel mounted pulley. Check that the routing of all VG ropes and pulleys is clear and straight.

It is possible for the VG activation cable which runs along the leading edge to become caught under the front end of a bottom surface batten pocket. This is most likely to happen if the bottom surface battens are installed before the crossbar is tensioned. You should therefore be sure to install the bottom surface battens only after the crossbar is tensioned. Also, during the preflight, before cycling the VG system, you should check specifically to see that the VG cables on each side are not caught under the front of any bottom surface batten pocket.

Check the VG operation - the pull should be light initially, becoming harder as the VG tight limit is reached. The return on release should be smooth. At the full loose end of the travel, the VG may not

release all the way with the glider unloaded. During VG operation, visually check for the free operation of the VG cam lever at the leading edge crossbar junction.

With the VG set tight, the sprog paddle slides forward on the transverse batten. Make sure that at VG full tight the rear end of the paddle does not slide past the rear edge of the transverse batten, or the system could malfunction.

Check that the front keel pocket is secured to itself with the mating velcro surfaces, and that all VG cables and ropes are inside the keel pocket.

Whenever you undo the velcro attaching the two sides of the front keel pocket to one another, you must be sure when reattaching them that the sweep wires are fully inside the keel pocket. Otherwise the keel pocket can be ripped away from the sail.

Check the crossbar center plate and wedge assembly including the following: The eight nuts and bolts which attach the crossbar plates to the wedge. The four circlips which retain the crossbar pins which hold the crossbars to the center plates. The shackle which holds the crossbar hold down strap to the front of the wedge. The attachment of the VG triple block pulley to the bottom front of the wedge. The attachment of the sweep wire, plastic glide, and retaining strap at the rear of the crossbar center wedge. The routing and attachment of the VG cables, including the forward triple block and the attachment of the VG cables to the top of the noseplate.

Also, visually inspect the crossbars by sighting along the length of the crossbars looking for any evidence of damage.

Pull back the neoprene protectors and check the control bar apex bracket hardware, including the clevis pin safeties, the control bar top plug bolts and nuts, and the elbow to apex slider bolt and nut.

Inspect the apex slider to verify that the ears have not been bent in a hard landing, and that the bottom and side plastic glides are properly in place.

Laying the Glider Down Flat

Once the glider is assembled it can easily be laid down flat on the ground.

Disengage the spring loaded apex slider lock from the slider assembly. On older gliders, remove the clevis pin from the control bar apex slider to allow it move forward on the track. If the control bar apex is is not released from the aft locked position, the sidewires will become extremely tight as the control bar is rotated back and damage to the sail and airframe may occur.

Loosen the back-up hang loop to allow the control bar top to slide forward on the keel track. Detach the bottom of the nose cone. Disengage the keyhole tang (front wires) from the nose bolt. Pull the control bar apex all the way forward on the slider track. Lift the nose of the glider and rock it forward over the control bar, and then lay it down.

Reverse the procedure to set the glider upright again.

Setting the Glider Up Flat on the Ground

In areas where the ground is not rocky and when there are strong winds, you may wish to set up the glider flat on the ground. This is easy to do, and relatively few parts of the set up procedure are different from what has been described.

1. After unfolding the control bar and securing the basetube center sleeve, flip the glider over right side up with the control bar still flat under the glider.
2. Spread the wings and install all the battens, sprogs, washout tubes and the wingtip fairings. (Note: Perform all the normal preflight operations as described above).
3. Tension the crossbar.
4. When ready, raise the nose of the glider and pull the control bar forward under the glider. Push the control bar apex fully aft, engage the spring loaded apex slider lock, and secure the bottom front wires.
5. Install the nosecone.

Launching and Flying the Fusion

Before launching, hook in to the glider and do a careful hang check.

1. We recommend that you launch with the VG set between full loose and 1/3 on.

   If you launch with the VG set partly on, you must make sure that there is no way that the excess VG rope can catch on anything on the ground or that you can step on it. One way to do this is to fold the rope into a flat loop about eight inches long, and tuck it around the outside of the right downtube above the bottom front, rear, and side wires.

   If the wind is more than 10 m.p.h. or gusty you should have an assistant on your nose wires on launch, and, if necessary, an assistant on one or both side wires. Make sure all signals are clearly understood. The angle at which you hold the glider should depend on the wind speed and slope of the terrain at launch; you want to achieve a slight positive angle of attack at the start of your run.

2. Run aggressively on launch and ease the bar out for lift off.
3. The flying characteristics of the Fusion are typical of a high performance flex wing. Make your first flights from a familiar site in mellow conditions to give you time to become accustomed to the glider.
4. We recommend that you hang as close as possible to the basetube in the glider - this will give you lighter control pressures and better control.

Minimum controllable airspeed and minimum sink airspeed

There are two important airspeeds with which all hang glider pilots should be intimately familiar; minimum sink airspeed (hereinafter referred to as MSA) and minimum controllable airspeed (MCA). *The most important of these two is MCA*. Minimum sink airspeed is that speed at which your descent rate is the slowest possible. It is the speed to fly when you want to maximize your climb rate in lift, or slow your rate of descent to a minimum in non lifting air. (You would normally not fly at MSA in sinking air; the strategy there is normally to speed up and fly quickly out of the sink. By minimizing your time spent in the sinking air you minimize altitude lost, even though you have momentarily increased your sink rate by speeding up.)

Minimum controllable airspeed is that speed below which you begin to rapidly lose effective lateral control of the glider. Recognition of this speed and its implications is a more subtle problem than many pilots realize. We have seen several instances of pilots who were having a lot of trouble flying their gliders simply because they were unknowingly trying to fly them too slowly; below the speed at which the glider responded effectively to lateral control inputs. It is our opinion that a great percentage of hang gliding accidents are caused by inadvertent flight below MCA, and subsequent loss of control of the glider with impact preceding recovery. Such incidents are usually attributed to "stalls," but it is not the stall per se that causes the problem, indeed the glider need not even be "stalled" in the traditional sense.

There is no necessary cause and effect relationship between minimum sink speed and minimum controllable airspeed. MSA is determined primarily by the wing loading and span loading, the wing planform,

the wing section characteristics, etc. MCA is influenced most heavily by the tension in the sail; how much "billow" the glider has. However, in your Wills Wing glider, as in most hang gliders, MCA and MSA evolved towards a common value during the design and development of the glider. This is so because if the wing is tuned so tight that minimum controllable airspeed is at a higher speed than minimum sink speed, then effective sink rate performance can be improved by loosening the wing so as to lower the minimum controllable airspeed. Conversely, if minimum controllable airspeed is reached at a speed below that of minimum sink, the wing can usually be tightened so as to improve glide performance without significant sacrifice in other areas.

Using wing tufts to find the minimum sink speed of your glider

Your Wills Wing glider has been equipped from the factory with short yarn tufts on the top surface of each wing. The shadow of these tufts will be visible through the sail. The tufts are useful for indicating the local reversal of the airflow which is associated with the onset of the stall in that portion of the wing. You can use these tufts, as described below, to help determine when you are flying at minimum sink airspeed.

On a flex wing hang glider, the wing experiences a gradual and progressive stall, and different spanwise stations of the wing stall at different angles of attack. The tufts have been placed on your wing at the approximate location of the first onset of stall. As the angle of attack is raised further, the stall propagates both outward towards the tips and inward towards the root. If you wish to observe the stall propagation across the whole wing on your glider, you can cut some more tufts from knitting yarn, about 3-4" long, and tape these to the top surface of your sail across the rest of the span.

During normal flight the flow will be chordwise along the wing, and the tufts will point towards the trailing edge. When the wing stalls, the tufts will reverse direction, indicating the local flow towards the leading edge.

At the first onset of stall, the tufts will indicate the impending separation by first wiggling, and then deflecting spanwise, before they fully reverse and point forward. The first onset of stall occurs well before the familiar "stall break" in which the glider pitches uncontrollably nose down to recover from the stall. By the time the stall break occurs, all tufts but those farthest outboard will have indicated reversed flow.

The first onset of stall as indicated by the first tickling of the tufts indicates that you have reached the angle of attack corresponding to the glider's minimum sink airspeed. This will also be very close to the glider's minimum controllable airspeed. To find the glider's minimum sink speed, fly the glider in smooth air, early in the morning or late in the afternoon. When you are well away from the terrain, and well clear of other aircraft, look up at the wing tufts while you very gradually reduce the speed of the glider. Note the speed at which the first tuft first begins to wiggle just prior to blowing spanwise toward the tip. This is your speed for minimum sink rate. Familiarize yourself with the position of the control bar relative to your body at this speed, with the sound and feel of the wind, with the reading on your airspeed indicator, and with the feel of the glider in terms of pitch and roll pressures. Most of the time when you are flying it will not be practical to look up for extended periods of time at your tufts. That is why familiarization with these other, more accessible indicators is important.

After finding your minimum sink speed, experiment with roll control response at speeds just above and just below this speed to find the value of MCA and the corresponding bar position and other indicators for this speed. Realize that your effective MCA is going to be higher and higher as the air becomes

more and more turbulent; control response that is perfectly adequate in smooth air will not be good enough in rougher air. Try flying the glider with the tufts fully reversed; you will probably find that the glider is somewhat controllable, but only with a lot of physical effort. Note that both MCA and MSA come well before the glider actually "stalls" in the traditional sense, i.e. pitches uncontrollably nose down. You may also be able to sense, or your vario may tell you that although the glider has not "stalled" (pitched nose down) your sink rate has increased significantly. In this mode the glider is "mushing."

Once you have familiarized yourself with the glider's characteristics in this range of speeds, you will not need to look at the tufts very often. You will know from bar position and bar pressure, and from the sound and feel of the relative wind when you are at your minimum sink / minimum controllable airspeed. In general, you should not fly your glider below this speed. Be aware, however, that when you are flying at minimum sink in thermal gusts and turbulence, you will experience gust induced separation of the airflow which will periodically cause the tufts on your sail to reverse.

Of course in a turn, your minimum sink *speed* goes up because you are banked, and the bank effectively increases your wing loading which increases your flying *speed* for any angle of attack. But note this: *The tufts indicate angle of attack, without regard to airspeed!* Therefore, if you practice flying various bank angles in smooth air (while well away from any terrain or other gliders) and watch your tufts (on the inside wing, which will be at the highest angle of attack) you will get a feel for the way your minimum sink speed varies at varying bank angles.

Also be aware that in some thermalling situations, such as when trying to maximize climb rate in a thermal with a very strong and very small core, there may be an advantage in overall effective climb performance to flying so slowly that some portion of the inside wing is partially stalled most of the time. This is, however, an advanced and potentially dangerous technique - it is the beginning of a spin entry, and if pushed just a little too far can result in a sudden and extreme loss of control and / or altitude. In general, if the tufts are indicating flow reversal associated with the stall, you will improve both performance and controllability by pulling in and speeding up a little.

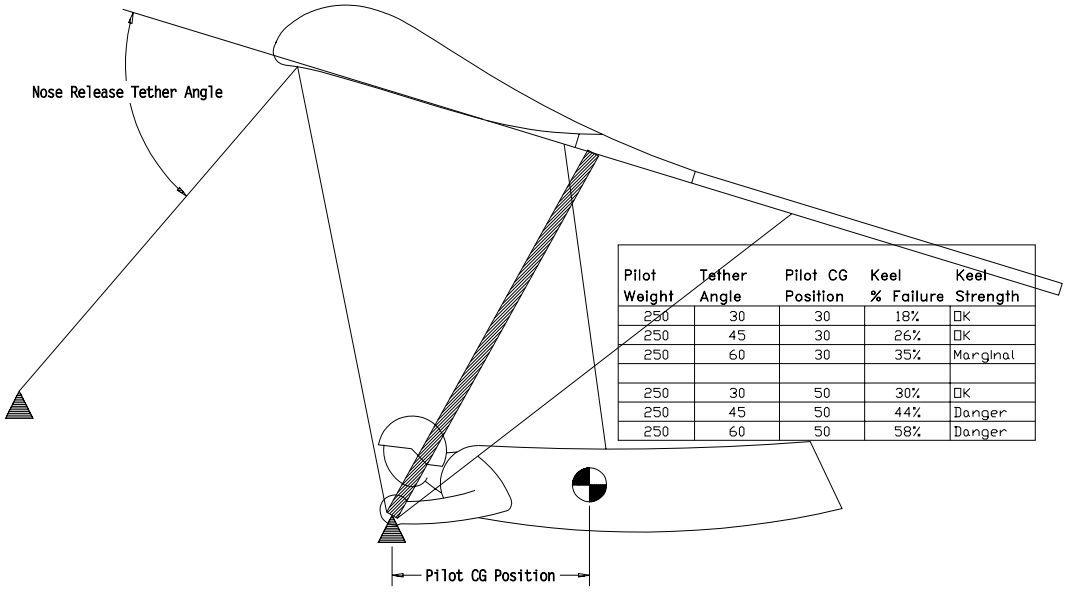
One final caution: from time to time a tuft may to stick completely to the sail, and fail to properly indicate the direction of local flow. This may result from static buildup, or from the fine threads of the yarn becoming caught on a seam or some dirt or imperfection in the sail. The tuft may stick while indicating normal flow, but most often it will stick after having reversed, such that the tuft will indicate a stalled condition that does not exist. One clue in this situation is to note whether or not the tuft is wiggling. Since flow reversal occurs during a turbulent separated flow, a reversed tuft should be wiggling rapidly. If it is not, it is probably stuck. A tuft indicating normal flow will not usually wiggle. An occasional application of silicone spray to the tufts, and making sure that they are positioned so that they cannot catch on any seam will minimize the problem of sticking.

Towing

Because of the lack of a kingpost and top rigging on the Fusion design, tethering the glider by the nose, such as is commonly done during platform towing operations, creates the potential for overloading the keel tube of the glider which could result in a structural failure. To avoid overloading the keel, any tether line attached to the nose should pull as much as possible in line with the keel, and in no case in a direction more than 45 degrees below the line of the keel tube itself.

As the following table indicates, the load on the keel is also very sensitive to pilot weight and CG position. With a nose release tether angle of 45 degrees, the load on the keel is marginally acceptable at a pilot position corresponding to a free flight airspeed of approximately 30mph. With an arms extended pilot position, the keel will be overstressed and the front wires will be quite slack.

A keel angle of 7 degrees has been used for platform tow operations, which allowed the glider to start lifting off the chocks at approximately 30 m.p.h.



Pilot Weight	Tether Angle	Pilot CG Position	Keel % Failure	Keel Strength
250	30	30	18%	OK
250	45	30	26%	OK
250	60	30	35%	Marginal
250	30	50	30%	OK
250	45	50	44%	Danger
250	60	50	58%	Danger

Trimming Your Glider in Pitch

The fore and aft location along the keel of your hang point is commonly (if mistakenly) referred to as your "CG location." The location of this hang point will, all other things being equal, determine at what angle of attack and airspeed your glider will naturally tend to fly (or trim), and therefore how much bar pressure there is to pull in from trim to a given faster speed, or how much pressure there is to push out from trim to a given slower speed. The farther forward your hang point is, the faster the glider will trim, the less effort will be required to fly fast, and the more effort will be required to fly slow. If your hang loop is too far aft, it will make the glider more difficult to control in roll, especially in turbulent air and when the nose pitches up on entering a strong thermal.

On the Fusion, hang loop fore and aft position is adjusted by repositioning the elevated hang bracket on the keel. The bracket is secured by bolt a through the keel. There are three holes in the keel and two holes in the bracket to allow six positions in increments of 1/2" over a range of 2 1/2" of adjustment. The assembly is illustrated in the diagram ***Middle/Rear Keel Assembly*** in the back of this manual.

Do not mount the pillar to the keel with the sloping end facing forward. The structural loads on the pillar can only be supported properly when the pillar is properly mounted with the vertical end at the front, and the sloping end to the rear.

We recommend that you not stow your glider bag, or any other cargo on the glider. The practice of putting your glider bag inside the sail, for example, can drastically alter the pitch trim and static balance of your glider, and adversely affect its flying and landing characteristics. The best place to carry your glider bag or other cargo is in your harness.

In the absence of the use of tufts, it has become common for pilots to talk about bar position, or about indicated airspeed, when trying to communicate how to trim a glider properly or how to fly a glider at the proper speed for a given situation. The problem is that these methods are unreliable and inconsistent from one pilot to another even on the same glider. The angle at which your harness suspends your body in your glider has a great deal to do with your perception of the bar "position" relative to your body. Airspeed indicators vary in their indicated airspeed depending on the make of the instrument, its calibration, any installation error, etc. The use of tufts gives you an absolute first hand indication of the actual aerodynamic event associated with two critically important airspeeds on your glider. It is a potentially useful tool that may improve your flying.

The factory setting for the elevated hang bracket is the forward of two holes in the elevated hang bracket and the middle of the three holes in the keel. The desired trim speed should be close to minimum sink airspeed (MSA), and not less than minimum controllable airspeed (MCA) at any VG setting.

Speeds to Fly and Using Your Airspeed Indicator

The Wills Wing Hall Airspeed Indicator has been specially designed to help you fly your Fusion at the proper speeds for optimum safety and performance, and is provided with your glider.

There are four color coded bands on the ASI:

White: This is the range from 18 m.p.h. to 28 m.p.h.. This is the normal thermalling speed range for light to moderate thermalling conditions. Try to keep your speed within this range when thermalling in light to moderate conditions. Very strong or turbulent conditions will warrant a faster flying speed.

Green: The top of the green region represents the placarded maximum rough air and maximum maneuvering speeds. This speed of 46 m.p.h. should not be exceeded except in smooth air, and no abrupt large control deflections should be used above this speed. In significant turbulence it is recommended that you keep the airspeed "in the green" for best control and stability and best structural margin at all times.

Yellow: This region represents the upper speed range between maximum rough air / maximum maneuvering speed and the speed never to exceed. You should fly in this range only in smooth air as described above.

Red Line: This is your never to exceed speed. At no time should you fly faster than this speed.

The design of the Hall type airspeed indicator involves using a ram air versus static pressure differential to raise a disc in a tapered tube against the force of the weight of the disc. Because of this the ASI has certain operating limitations:

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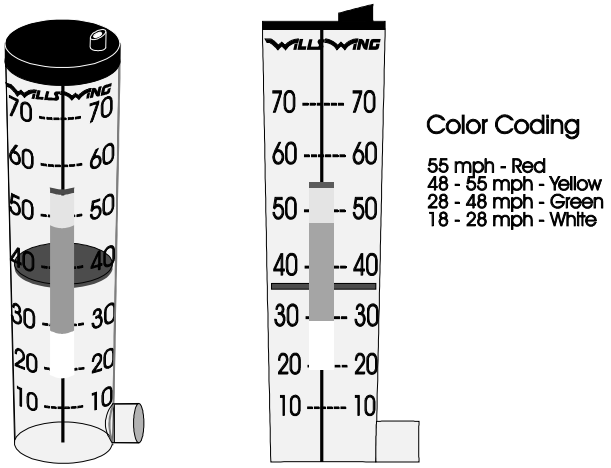
a. It is only accurate in one G flight. If you are turning at a bank angle of more than 30 degrees, the ASI will read artificially low as a result of the G loading of the turn. Reliance on the ASI for limiting airspeeds in high banked sustained spiral maneuvers will likely cause you to exceed the placarded speed limitations of the glider and will compromise your safety.

b. It is only accurate when within 15-20 degrees of the vertical orientation.



Using the VG System

The Fusion VG system uses a 7:1 reduction system of pulleys and cam action levers between the outboard end of the crossbar and the leading edge to enable a very wide VG range. The change in airframe nose angle from VG loose to tight is over 3 degrees. Unlike conventional VG systems, the airframe anhedral is completely unaffected by VG position. Tightening the VG increases the spanwise tension which the airframe places on the sail, reducing the spanwise twist and the sail elasticity. The result is an increase in L/D performance and a reduction in roll control authority and roll control response.

The VG is activated by pulling laterally on the VG rope and then moving the rope aft to set the rope in the V-cut knife cleat. The recommended procedure for increasing VG tension is to grasp the rope firmly at the cleat, and pull straight across behind the basetube.

VG full loose is a very useful configuration for maximizing control ease and response while retaining excellent performance. It is the recommended VG setting for working lift when any significant degree of turbulence is present, or when you are in proximity to terrain or other gliders.

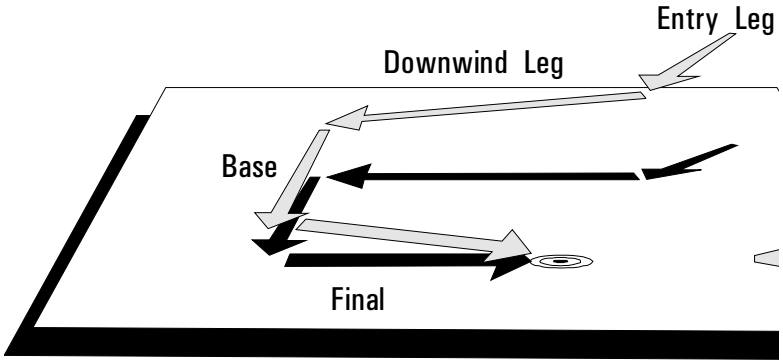
Between VG full loose and VG one half, the glider retains good ease of control and control response. Tighter than VG one half, the glider's roll pressures increase significantly and the roll rate becomes significantly slower. Tighter VG settings are recommended for straight line gliding, or for flying in smoother conditions when well clear of both the terrain and of other gliders. The stall characteristics of the Fusion at tighter VG settings are more abrupt and less forgiving. Full breaking stalls and accelerated stalls at tighter VG settings are not recommended.

The standard delivery configuration for production Fusions includes a 1.25 inch extension between the keyhole bracket and the sweep wire thimble (see the assembly diagram ***Fusion Crossbar Center***). This modification reduces sail tension across the VG range and improves handling at every VG setting. This extension can be removed at the pilot's discretion, however it is preferable to add 1/4 inch shims to the sail before removing the extension.

Landing the Fusion

We recommend using an aircraft landing approach (45 entry leg, downwind leg, base leg, and final leg) whenever possible, and we suggest that you practice making your approaches with as much precision as possible. Under ideal conditions, landing approaches are best done so as to include a long straight final into the wind at a speed above best L/D speed. In a very limited field, or a field which slopes slightly downhill, when landing in light wind, you may need to make your final approach at a slower speed, perhaps as slow as minimum sink, in order to be able to land within the field. In winds of less than 5 mph, if the slope is steeper than 12:1, you should seriously consider landing downwind, uphill; or crosswind, across the slope. Landing attempts which require slow speed approaches, maneuvering around obstacles or into a restricted area, or downwind or crosswind landings are not recommended for pilots below an advanced skill level.

Standard Aircraft Approach Pattern



Making your approach VG full loose to VG 1/3 will also increase the glider's roll sensitivity, and some pilots have had difficulty with roll yaw oscillations on final. The best way to avoid this is to fly your entire approach at a constant airspeed, and to control your touchdown point by making adjustments to the shape of your pattern. In particular, we recommend against the technique of make a diving turn onto final. This maneuver, sometimes called a "slipping turn" is often taught to student hang glider pilots as a way to lose altitude during the approach. While it will work reasonably well with low or medium performance low aspect ratio gliders which have high levels of yaw stability and damping, and which are able to lose energy by diving because of the large increase in drag at higher speeds, on a high performance glider this technique serves only to convert the energy of altitude to energy of speed, while at the same time suddenly increasing the glider's sensitivity to control inputs. The result is a high probability of overshooting the intended landing point and the prospect of roll / yaw oscillations which may interfere with a proper landing. If you develop good habits and the skills to fly precise approaches now, it will make your transition to higher performance gliders easier later on.

Once established on a straight final approach, with wings level and flying directly into the wind, you should fly the glider down to where the basetube is between three and six feet off the ground. At this altitude, let the control bar out just enough "round out" so that your descent is arrested and your flight path parallels the ground. The remainder of your approach will consist of bleeding off excess speed while paralleling the ground and keeping the wings level and the nose into the wind until it is time to "flare" for landing.

Prior to the landing flare your body position should be generally upright, but slightly inclined forward, with your head and shoulders forward of your hips and your legs and feet trailing slightly behind. Your hands should be at shoulder width and shoulder height on the uprights. You should be relaxed, with a light grip on the bar, and your weight should be fully supported in your harness and not at all by your arms. There are several options for when to make the transition from prone to this upright position. Some pilots favor going upright with both hands moving to the downtubes while still at altitude prior to the start of the approach. Others transition at the start of the approach to a semi upright position with one hand on a downtube and one hand on the basetube, and complete the transition by moving the other hand to the downtube just a few seconds prior to flare. Still others fly with both hands on the basetube until established on final glide, and then transition one hand at a time to the downtubes prior to flare.

Whichever method you use, there are a few important principles to observe. The first is that you should not make any change in hand position unless you are flying at or very near trim speed. At speeds faster than trim, you will be holding the bar in in pitch against substantial force, and if you let go to move your hand the glider will pitch up and roll towards your remaining hand. The second is that while moving either hand, you have no control over the glider. You should move only one hand at a time. Even so, if you can't make the transition in the position of each hand quickly and reliably, you should transition both hands while at altitude, before you start your approach. Otherwise, if you fail to make a quick transition, you could be out of control close to the ground, and suffer a turbulence induced change in heading or attitude without sufficient time to recover. Many pilots make the mistake of trying to change position while flying fast and close to the ground, and experience a dangerous loss of control as a result. A third principle to observe is that if you are using a "pod" type harness, you should unzip and confirm that your legs are free to exit the harness at least 500 feet above the ground and before you start your approach. If there is any problem finding the zipper pull, or dealing with a stuck zipper, you don't want to have to try to fix that problem while also flying the approach.

Once established on a wings level short final, into the wind, body upright and with both hands on the downtubes, your final concern is the timing and execution of the landing flare. The goal is to arrive on the ground, on your feet, under control with the glider settling on your shoulders. If the wind is 15 mph or more, you will not really execute a flare at all; you will simply slow to minimum flying speed, put a foot down, and step onto the ground. In lighter winds, you will want to use some combination of a final nose up flare, and running out your landing, in order to finish the flight on your feet with the glider settling on your shoulders. The lighter the wind, the stronger should be both your flare and your run.

The traditional method of landing in light or no wind calls for a sharp, aggressive flare at precisely the correct moment. This technique works fine when done correctly, but it's not easy to get the timing just right. Flare too early and you will climb, and then fall with the nose pitching down. Flare too late and you won't get the nose up enough to stop your forward motion, and the glider may nose into the ground as you run into it from behind.

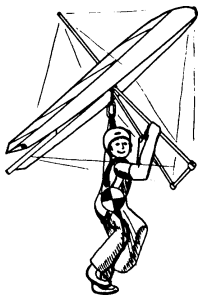
The flare timing process is made much easier by using a combination of a "crescendo flare" and a run out of the landing. As you bleed off speed on final, flying just above the ground, you are at first letting the control bar out towards its trim position. As the glider reaches trim speed, which will normally be one to three mph above stall speed, you begin to gently push the bar out to keep the glider from settling. At this point it is almost time to flare. As the glider enters the "mushing" range of angles of attack, it will begin to settle in spite of your continuing to ease the bar out. This should be happening well before your arms are significantly extended. At this point begin your flare by smoothly accelerating the rate at which you push out on the bar. At the same time, draw one leg forward, put a foot down,

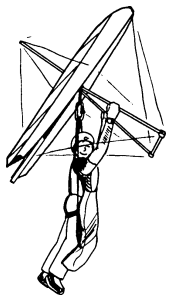
and start to run as hard as you can. This run should be very much like an aggressive take off run – your body should be leaning forward into the run and you should be driving with your legs. The difference here is that while you are leaning into your run and driving forward with your legs, your arms are extending fully from your shoulders, pushing out, and what feels like upwards, on the control bar in an accelerating, "crescendo" flare.

Done correctly, this type of flare / run combination will bring the glider quickly to a very nose high attitude, producing a great deal of drag and quickly arresting all of your forward motion. You will feel the glider pulling you from behind, resisting your attempt to run, and as you slow down the glider will settle gently on your shoulders. Even in no wind, you should not have to take more than a few steps. If your timing is a little early, and you feel the glider start to climb, simply stop pushing out and resume the flare when the glider again begins to settle. If your timing is a little late, your feet will touch down a little sooner, but as long as you're running and flaring at the same time, the glider will stay over your head or behind you.

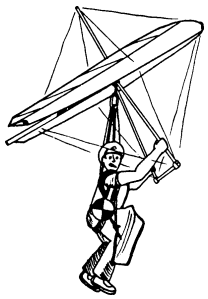
Note: Landing in a significant wind does not require a substantial landing flare; the pilot merely slows to near zero ground speed and touches down. The proper flare in light or no wind conditions is a dynamic action which causes a sudden and severe pitch up rotation of the glider. Pilots who have trouble with the flare, and with the glider nosing over during landing, usually do so because of one of the following problems:

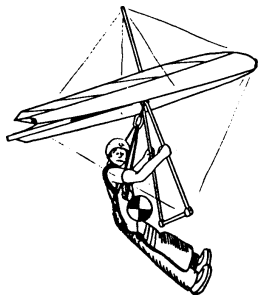
a. Harness leg straps too long / hanging too low below the glider, and / or hands too low on the control bar. This reduces pitch authority and prevents an adequate flare.





b. Improper body position - pilot leaning back, (away from the anticipated hard landing), with feet extended in front. This moves the pilot's center of mass forward ahead of his shoulders, effectively shortening the pilot's arms and reducing flare authority. The proper position is with the pilot's body inclined forward, with the shoulders out ahead of the pilot's center of mass. Thinking about pushing "up" instead of "out" when flaring may help you to maintain the proper forward inclined body position.





c. Slowing too much prior to flare, so that your arms are too extended to allow enough flare amplitude.

Fusion Breakdown

Breakdown of the glider is the reverse of assembly.

1. Remove the nosecone and put aside. Remove any instruments.
2. Detach the bottom front wires at the noseplate. Pull the nose battens off the front of the top noseplate. *Dismount the hang system spreader bar from the pillar.*

   If you do not remove the hang system spreader bar, you may damage both the crossbar and sail.

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3. Remove the wingtips, the number one through number five battens.
4. Reach in through the wingtip and unzip the internal fabric rib at the #2 batten. This is necessary to allow the washout tip to fold against the leading edge. Disengage the washout tip by pulling it straight aft out of the sleeve. Pull the front end of the washout tube towards the wing tip to fold the washout tube forwards along the leading edge tube.
5. Alternately: (do not unzip the internal fabric rib) disengage the washout tube by pulling it out the opening in the bottom surface at the junction of the no. 2 batten. Fold it forward furled in the sail. This method is quicker, but it is difficult to roll the sail neatly at tip area.

   Alternately: Fusions assembled after 6-25-97 have a different washout tube bungee retension system that allows the tube to be disengaged, folded to the rear and stowed inside the sail without unzipping the fabric rib.
6. Unzip the sprog access zipper and detach the sprog securing clip from the ring on the sprog end paddle. Leave the sprog end protruding from the zipper opening in the bottom surface; as you fold in the wings and roll the sail, the sprog will fold forward along the leading edge with *the rear end of the sprog remaining outside the sail.* Do not remove the transverse batten from the sail. Pull the neoprene cover over the end of the sprog paddle to protect the sail.
7. Roll the sail at the wingtips and install the wingtip cover bags. Store the tip fairings one inside the other and place between the leading edges aft of the keel after the glider is in the bag.
8. Detension the crossbar and remove all the remaining top and bottom surface battens. Leave the nose battens in the sail.
9. Fold the wings in pulling the sail over the top of the leading edges.
10. There are two triple block pulleys in the VG system. One is attached to the crossbar center juction and the other to the cam VG activation cables. During breakdown, the block attached to the VG activation cables can drop down and become pinched between the frame, damaging the sail and/or tubing. There are several effective methods for safely stowing the block. It can be above or below the keel—alternately, you can pull the cord at the front of the crossbar junction and lightly cinch the two blocks together before you furl the sail. Gliders manufactured after January 1998 have a bungee tether to pull the pulley above the keel as the wings fold in.
11. Make one more fold in the sail bringing the trailing edge towards the keel. Roll the sail gently and carefully, and install the velcro sail ties.

Do not attempt to stuff the sail between the mylar pocket and the leading edge tube at any point behind the kingpost base. The internal fabric ribs prevent this. Because of the fabric ribs, the rear edge of the mylar pocket in the last 1/3 of the leading edge has a strong tendency to become creased at the rear edge of the mylar insert. To prevent this it is necessary to roll the aft part of the sail very gently, install the aft velcros loose, and then, as a final step, work your way along the rear edge of the mylar pocket as far down towards the tip as possible, pulling the sail behind the mylar pocket away from the leading edge so that the mylar pocket lies flat and is not curled under at the rear edge.

12. Install the glider bag. Flip the glider over onto the ground. Pull the rear keel out from between and slightly above the leading edges. Stowing the keel between the leading edges causes wear on the bottom surface sail because of interference with the cam VG hardware.
13. Fold up the basetube. Replace all protective bags as you pack the glider away.

When folding in the folding basetube take care to avoid the following two problems:

a. Do not fold the basetube together with the center sleeve not fully retracted from the center hinge. You will damage the sleeve.
b. Do not fold the basetube together with your hands or fingers around either the basetube or the lower portion of the downtube. It will hurt.

Fusion Stability Systems

Several design features of the Fusion determine the glider's degree of stability in pitch:

a. The combination of wing sweep and spanwise twist.
b. Reflex in the root section, the degree of which is determined by the lengths and hole locations of the keel, the control bar and front to rear bottom wires, and by the shape of the root battens.
c. The alignment of the sprogs, and the height at which they and the transverse battens support the trailing edge, and the alignment of the washout tubes, and the height at which they support the trailing edge.

The transverse batten is designed to support a load applied at each end while supported in the center, as is the case when installed in the glider. Loading the batten in any other manner may damage it.

d. The shape of the preformed battens and the internal fabric ribs, and adjustment of the internal velcro attachments which define the airfoil.

Correct attachment and proper adjustment of the sprogs are critical to providing adequate stability at low angles of attack, particularly those below the normal operating range.

Fusion Sprog Adjustment and Flight Testing

The Fusion uses one internal sprog per side in combination with one transverse batten spanning three chordwise battens as an integral part of a system to provide pitch stability. Their function is to support the trailing edge of the sail at low angles of attack, and thus provide a nose up pitching moment.

Sprog measurement

The sprogs are adjusted at the factory to their proper settings. You can check this adjustment as follows:

1. Fully assemble the glider and then lay it flat on a level floor. Place enough weight on the nose and the rear end of the keel so as to press them against the floor (the rear keel will have the basetube between it and the floor).
2. Measure the height of the trailing edge at the number four battens above the floor. This should be at least 11.5".

Alternate sprog measurement

1. Fully set up glider, VG Loose on a reasonably level surface.
2. Place two equal supports, about 30" tall, under the rear end of each leading edge, so as to lift the keel off the ground and take up any slack in the bottom side wires.
3. Tie a lightweight thread tightly across wing from one # 4 batten end to the other. (The number four is the middle batten supported by the transverse batten, and the one immediately adjacent to the sprog.)
4. Press firmly on end of #4 batten, release, then measure the height of the thread above the keel. This should be 5.5"
5. Note that this method will not disclose sprogs that are assymetric. If, after achieving the 5.5" measurement, you have a turn in the glider which is only present at tighter VG settings, lower the sprog on the side the glider is turning towards, and raise the other sprog by the same amount.

Method of adjustment

1. To adjust the sprog height, fully unzip the access zipper to gain access to the sprog center junction.
2. Unbolt the sprog cable from the center junction, taking care to maintain the rotational alignment of the sprog at its original setting.
3. At the front of the sprog is a threaded adjuster. To raise the sprog, turn the entire sprog counter clockwise. To lower the sprog, turn it clockwise. One full turn raises or lowers the sprog about one half inch.
4. Re-attach the sprog cable and press down firmly on the rear end of the sprog to seat the cable before checking the measurement again.

Test flight

If the sprogs are set too low, it may cause a reduction in pitch pressures at tighter VG settings, and there will be a reduction in pitch stability at angles of attack below normal flight. This stability reduction could increase the probability of a turbulence induced tumble or other in-flight stability related loss of control. If the sprogs are set too high, it may cause excessive pitch bar pressure at high speeds, and excessive roll control pressures, lag in roll response, and adverse yaw. Please be aware that flight testing encompasses a very limited angle of attack range and that there is no correlation between pitch stability in the flight test envelope and pitch stability in the extended angle of attack range that is investigated on a test vehicle. In particular, do not assume that adequate stability is only contingent on positive pitch pressure during flight testing. However, in the case of the Fusion, excessive top steady state speed with pilot full forward is a significant indicator that the sprogs may be set too low. If you can maintain a steady state speed of more than 60 mph indicated in a normal pilot full forward body position, you should check and re-adjust your sprogs as necessary.

We have found that due to the high loads imposed on the sprog cables and hardware, the sprogs will tend to lower themselves significantly over time. It is therefore very important, in order to maintain pitch stability compliance, that sprog adjustment should be monitored and adjusted throughout the life of the glider using the procedures described above.

Maintenance

You should continually maintain your glider in a proper state of tune and repair to insure optimum airworthiness, performance and flight characteristics. Failure to properly maintain your glider may lead to a dangerous loss of strength, stability or control responsiveness of the glider. Following any mishap that results in damage to the glider immediately have any damaged component repaired or replaced. We recommend that you have all such maintenance work done by your Wills Wing dealer. In addition, please follow the following maintenance schedule:

Every month

1. Check the adjustment of your sprogs, as described in the last section.
2. Check your battens on a flat level floor against the batten diagram provided, and correct any that deviate from the pattern by more than 1/4".
2. If you fly in a dusty or sandy environment, it will help to prolong the life of your batten pockets if you wipe each batten with a rag before you install it in the sail.

Every six months

1. Have a complete inspection performed on the glider and replace any suspension system component that shows any wear, and any cable that shows any kinks, wear, damage, corrosion, etc.
2. Inspect all bolts for tightness, all safeties for proper installation and possible damage. Inspect plates and fittings for damage, holes in tubes for elongation.
3. Inspect the sail for wear, tears, UV damage, loose stitching, etc.
4. Disassemble basetube pulley assembly, clean, lubricate with white grease, and re-assemble.
5. Lightly spray all zippers on the glider with silicone spray lubricant. Also spray your battens before you install them in the glider to lubricate the insides of the batten pockets. Do not use any other type of lubricant. Wipe off any excess silicone so that it does not attract dirt.
6. Inspect the composite crossbar and all associated fittings. Look for any visual evidence of damage to the spar. If any damage is suspected, remove the spar completely from the glider for a more thorough inspection, and contact Wills Wing.
7. Inspect the sprogs, sprog hardware and sprog cables. If the sprogs have been loaded heavily, it is possible that the sprog tubes may have split and the cables may have been stretched.

   The normal cable length is 19.5" from hole center to hole center. Any cable which exceeds this measurement by more than 1/16" should be replaced. Also check the attachment tangs for any sign of elongation of the holes. Replace if elongation is found.

   Pay special attention to the carbon fiber tubes of the sprog assembly. Carefully inspect the perimeter of the tubes on both sides of the aluminum fitting in the middle of the assembly for splitting or cracking. If you suspect any damage to the composite part of the sprogs, remove them from the glider for a more thorough inspection and contact Wills Wing.

Be careful whenever you handle carbon fiber parts - carbon fiber splinters can be dangerous.

Note: Sprogs manufactured in 1997 were assembled with a slight downward bow at the center joint.

Every year

1. Have the sail completely removed from the frame, and disassemble all frame components. Inspect every part of the glider for any damage or wear. Inspect the tubes for straightness and for signs of corrosion. Note that the rear leading edge is secured in the front leading edge by two reducers, and that one is concentric (front) and one is eccentric (rear). As a result, the rear leading edge is at an angle to the front leading edge and the leading edge as an assembly will appear to be slightly bent out and down at the junction. This is normal and by design.
2. Anytime you have the sail off the frame, turn the sail inside out through the bottom surface center zipper and inspect all of the batten pockets and batten pocket terminations.
3. Replace bottom side wires and hang loops.
4. Replace the VG ropes.
5. Remove the transverse batten and inspect for damage. There should be no more than 1/4 inch of bow, measured unloaded, in the center, on a flat surface.

Special circumstances

1. Any time you suffer a crash or extremely hard landing you should have an "annual" inspection done on your glider to insure that you find all damaged parts. Following any hard landing, be sure to inspect the apex slider, the control bar legs and basetube, and all control bar fittings for damage. Any time you replace a control bar leg or basetube, you must carefully inspect all related fittings and replace any that are bent or damaged.

   Hard landings may also impose very high loads on the sprog assemblys and transverse battens. Inspect accordingly.
2. If your glider is ever exposed to salt water you will need to have the glider completely disassembled in accordance with the recommended annual inspection procedure. All frame parts will need to be disassembled, including the removal of all sleeves and bushings, flushed liberally with fresh water, dried completely, and treated for corrosion inhibition with LPS-3 or other suitable agent.
3. Cleaning Your Sail - Keeping your sail clean will extend the life of the cloth. When cleaning the entire sail you should generally use only water and a soft brush. You may clean small spots or stains with any commercial spot remover that is labeled for use on polyester. Such cleaning agents are available at the supermarket or drug store, or you may order a cleaning solution from Wills Wing through your dealer.

A note about cables and cable maintenance

The cables which support the glider's airframe are critical components of the glider's structure, and must be maintained in an air worthy condition. It is a general practice in the design of aircraft structures to design to an ultimate strength of 1.5 times the highest expected load in normal service. Hang glider cables, like other structural components on the glider, are typically designed with a structural safety factor of only about 50% above the expected maximum load. No significant loss in cable strength can be tolerated.

A cable with even a single broken strand must be replaced before the glider is flown again. A cable which has been bent sharply enough to have taken a permanent set (will not lie flat in a straight line when all tension is removed) must also be replaced immediately. If it is not, subsequent tensioning and de-tensioning of the cable will induce fatigue, and the cable will fail. In tests we have conducted, a cable bent one time to 90 degrees, and then loaded to the equivalent of a normal flight load 100 times (corresponding to 100 or fewer flights), failed at only 56% of its original strength.

Some degree of fatigue due to repeated bending of cables is almost unavoidable in an aircraft that is assembled and disassembled with every flight. Bottom side wires are subject to the highest loads in flight, and are therefore the most critical. This is why we recommend that these wires be replaced annually, even if there is no known damage. The requirement for immediate replacement of a cable known to have been bent or otherwise damaged supercedes this annual replacement requirement.

Replacement cables should always be obtained from the factory, or, if not from the factory, from a reliable source known to use proper fabrication procedures. An improperly made cable may appear perfectly OK on visual inspection, but could fail in flight at a load much below the intended design strength of the cable.

Removing the Sail from the Airframe and Re-Installing

Many maintenance and repair procedures will require the removal of the sail from the frame. Please follow these instructions when removing and reinstalling the sail. Please read all the instructions for each operation before beginning.

Sail removal

You will need an unobstructed area six feet by thirty feet. Make sure the surface is clean. If it is abrasive, like rough concrete, you should either put down a protective tarp or be extremely careful not to scrape your sail.

1. Lay the glider on its back, unzip and remove the glider bag and put the battens aside. Remove the control bar bag.
2. Remove the tangs from the bolts that tether the sail at the noseplate. Completely unzip and separate the bottom surface zipper. Remove the screw and disengage the webbing zipper stop at the bottom nose area.
3. Spread the wings slightly, undo the velcro tabs inside the rear ends of the leading edges and then dismount the sail from the rear leading edges.
4. Detach the sprog bungee from the spog paddle.
5. Slide the sail up the rear leading edge and fold the washout tube outward, making sure that the cord is clear of the internal fabric rib (which should be unzipped at this time). Tape the washout tube to the tip of the leading edge to hold it in place.
6. Unbolt the bottom side wires from the crossbar and feed them through the hole and out of the sail. Unbolt the bottom rear flying wires from the rear keel. Reassemble the hardware removed onto the bolts in the original order so that it doesn't get lost. All disassembled assemblies on the glider must be reassembled in the proper order and orientation. Use the exploded parts diagrams in this manual to help you.
7. Undo the velcro which holds the front part of the keel pocket together.
8. Slide the frame out through the open center zipper. If you encounter resistance, stop and find out what is hanging up.
9. If you need to send the sail into the factory for repair, remove the mylar and the transverse battens. The mylar is removed from the front end of the mylar pocket. It helps to secure the opposite end of the sail to something solid, so that you can lay the leading edge out straight and pull the mylar straight out of the pocket. If you have trouble getting it to slide out freely, it is probably because the edge of the mylar has worked its way into the seam and gotten stuck on the adhesive seamstick tape. Work your way up and down the leading edge pocket rolling the mylar away from the seam until it is free along its entire length.
10. Remove the carbon sandwich transverse batten from the sail by opening the velcro closure at the #3 batten end of the transverse batten pocket and sliding the transverse batten out towards the wing tip.

Be careful handling the transverse batten - carbon fiber splinters can be dangerous.

11. Fold and package the sail carefully if you plan to ship it in for repair. Be sure to include written instructions of what you want done, your name and a phone number where you can be reached during the day.

Re-installing the sail on the frame

1. Install the mylar in the sail. (If the mylar pockets have been replaced you will need to trim the rear edge of the mylar by 1/2". Also, you will probably need to remove one 1/4" shim from the sail mount plug to mount the sail looser.) Make sure you install it right side up; the curved edge is at the front and on the bottom. The easiest way to install the mylar is to push it into the pocket using a long lofting batten attached to the end of the mylar insert which is first inserted in the pocket. A small diameter pin on the end of the lofting batten placed through a small hole in the end of the mylar insert allows you to push the mylar into the sail and remove the batten while leaving the mylar in place. You will have to stop from time to time to make sure the mylar is properly lying flat in the pocket. Do not push the mylar too far into the pocket. Make sure there are no folds in the mylar, especially at the tips. Make sure the mylar wraps in the proper direction to follow the sail around the leading edge as it enters the pocket.
2. Install the transverse battens in the batten pockets. The proper orientation for the transverse batten is with the flat carbon side (bottom side) of the batten facing the bottom surface of the sail. The top side of the batten should lay flat in the pocket against the top surface of the sail. Secure the velcro closure.
3. Position the sail on the floor with the keel pocket up and the wings folded over so that the leading edges lie along the length of the root line, with the mylar pockets lying on top.
4. Prepare the frame. Tape the sprogs and washout tubes to the leading edges. The sprogs should be folded back (towards the tip), and the washout tubes should be folded forward along the leading edge.
5. Position the frame with the bottom of the noseplate facing up and with the rear end of the leading edges at the nose of the sail. Slide the frame into the sail through the open bottom surface zipper, making sure that the leading edges of the frame pass properly into the leading edge pockets of the sail and don't get caught at the rear of the bottom surface near the root. As you feed the frame slowly into the sail, check periodically to see that none of the hardware is snagging on the sail or internal sail ribs. As the rear end of the sprogs reach the bottom surface access zipper, remove the tape and direct them outside of the sail. If you leave them inside the sail it will be difficult to deploy them without removing the rear leading edge. (You can deploy them by unzipping the #3 internal fabric rib all the way with the sail slid back slightly from the nose - i.e. nose tangs not mounted.)
6. After the frame is fully installed, attach the sail anchor tangs to the bottom noseplate hinge bolts. Install and adjust the clinch nuts to allow rotation of the tang. Align the axis of the tang with the leading edge. Also align the VG activation cable tangs on the top of the noseplate
7. Tie the sprog bungee to the sprog paddle.
8. Reconnect the bottom surface center zipper at the nose, zip part way up, and re-install the securing screw at the nose.

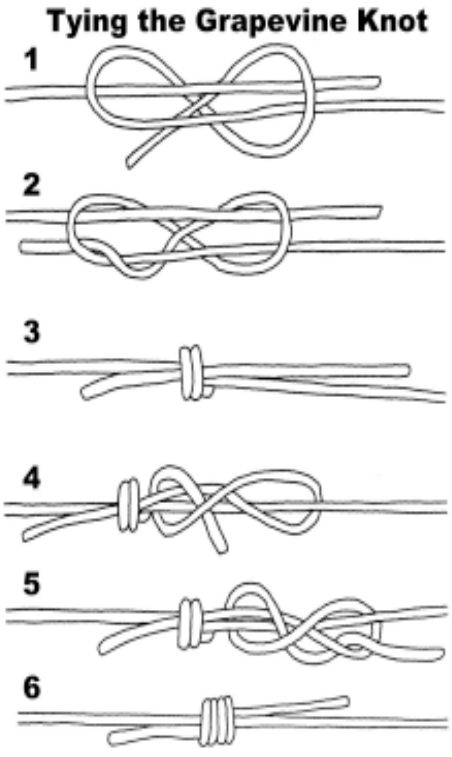
9. Make sure that the #2 internal rib is unzipped. Slide the sail forward of the washout tube and untape the washout tube from the leading edge. Slide the sail back, feeding the end of the washout tube between the open halves of the fabric rib zipper.
10. Mount the webbing anchor loops over the rear leading edge endcaps. Check that the internal rib zipper for the #2 fabric rib is not caught on the #1 batten stud. ***Make sure you mount the inner webbing loops in the endcap slots, not the outer "handle" loops!*** Make sure that the webbing lies flat and smooth in the slot, and that the sail is properly aligned when mounted. (Proper sail alignment is sometimes difficult to check at this time - recheck this when you do your fully assembled preflight of the glider). Secure the velcro retainer tabs.
11. Working through the camera mount zippers, insert the bottom side wires through the holes in the sail and attach to the crossbar, making sure that no cable is wrapped around a leading edge or crossbar, and that no thimbles are cocked or twisted. The VG activation cable passes between the leading edge and the side wire.
12. Bolt the bottom rear wires and sail retainer webbing strap to the rear of the keel.
13. Flip the glider up onto the control bar.
14. Spread the wings slowly and carefully, making sure that the sail rides forward as necessary at the nose without catching. ***Be careful: you can easily tear the sail open at the nose at this point.***
15. Feed the sweep wire through the keel pocket.
16. Finish the assembly of the glider completely according to normal assembly procedures.
17. Do a very careful and complete preflight of the glider according to the normal preflight procedure as explained earlier in this manual.

Replacing the Perlon hang loop

Some Fusions are equipped with a 7mm Perlon main suspension system that is double looped through the elevated hang 'T'. If you need to replace or adjust the loop, refer to the diagram for tying the knot.

Please note that it is essential that the back-up hang loop is the proper length.

During a hang check, with the pilot pushed out (full aft CG), the backup loop should have a minimum of 2 inches and not more than 3 inches of slack.



Glider Tuning

Dismounting and remounting the sail at the tip

A number of tuning procedures require you to dismount the sail at the rear leading edge. This can be most easily accomplished by using a large, flat bladed screw driver to pry the sail mount webbing off of the end of the leading edge. The same technique can be used to reinstall the sail. Take care not to damage the sail mount webbing, and when remounting the sail, be sure to mount the inner webbing in the slot, not the outer handle webbing, and be sure that the webbing seats squarely in the slot.

CG adjustment

This has already been covered in the section of this manual on using your wing tufts. Wills Wing recommends that tuning other than CG adjustment be performed by your Wills Wing dealer.

Turn trim

Turns are caused by an asymmetry in the glider. If you have a turn, first try to make the glider symmetrical in every way. If a turn only appears at VG settings of 3/4 to full tight, it may be an indication that the sprogs are set assymetically.

Airframe

Check the leading edges for possible bent tubes. Check that the keel is not bent to one side.

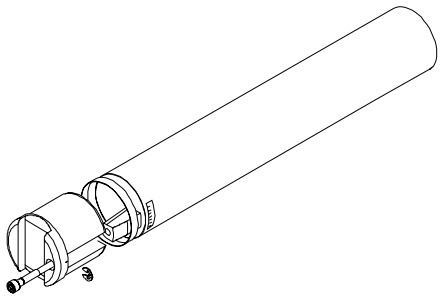
Check for symmetrical twist in the leading edges by checking for symmetry in the alignment of the sail mount plugs.

Battens

Check the battens for symmetrical shape and batten string tension. The tension should be progressive with minimal tension on the inboard battens to firm tension on the tip battens. As the sail ages, it shrinks and the inboard batten strings will become too tight and need to be adjusted or replaced. Excessive batten tension will cause poor handling.

Sail mount plugs - adjusting sail tension and rotational alignment

The molded plastic plug fits directly into the rear leading edge and is secured against rotation by a sliding wedge which is forced out against the inside of the tube as the allen screw is tightened. The proper installation procedure for the plug is to engage the allen screw three turns into the sliding wedge, install the plug into the rear leading edge, set the desired alignment, and then tighten the allen screw 15 additional turns.



Shims are added to the plug by sliding them over the end of the plug before the plug is inserted into the leading edge. The shims are thus visible with the plug installed.

Once the plug is installed, the rotational alignment can be changed by loosening the allen screw (an allen wrench is provided in your spare parts kit) to relieve the pressure of the wedge against the inside of the leading edge tube until the sail mount plug is free enough that it can be rotated.

If you loosen the screw too much, the wedge will fall off the end of the screw inside the leading edge, and you will have to dismount the sail to retrieve it. Start by loosening the screw ten turns, and then check to see if you can rotate it. If not, loosen it one turn at a time until it can be rotated.

If the cap screw backs out of the sail adjuster as you loosen it, it means that the circlip has dislodged from the groove in the screw. In this case you will need to tap on the end of the cap screw to disengage the wedge and free up the sail adjuster. You will then also need to dismount the sail, remove the sail adjuster, and replace the circlip. The original circlip can be reshaped and reused, or you can install a new one.

Sail tension

Check for symmetrical sail tension on the leading edges. In order to check this, sight the hem of the sail at the bottom of the leading edge tube relative to the noseplate on each side. Sail tension is adjusted by adding or removing shims in 1/8" or 1/4" increments to or from the sail mount plugs on the rear ends of the leading edges.

To remove or add shims, first dismount the sail mount webbing by pulling it free and then to the outside of the leading edge. You can use a flat bladed screwdriver to pry the webbing off, but take care not to damage the webbing. To remove the plug, first check and record the rotational alignment by noting the position of the scribe mark on the plug relative to the scale on the leading edge tube. Use the allen wrench provided in your spare parts kit to loosen the allen screw until you can remove the plug. Add or remove shims as necessary, and then reinstall the plug, making sure the alignment is correct. Twelve turns of the allen screw (after the first three turns to install the wedge) after installation of the plug in the leading edge will secure the plug in place.

Twisting a tip

After you have made everything symmetrical, if you still have a turn, you can correct it by rotating one or both sail mount plugs. A left turn is corrected by twisting the left sail plug clockwise (twisting the sail down at the trailing edge) or twisting the right sail plug clockwise (twisting the sail up at the trailing edge) or both. Twist counter clockwise on either or both plugs to correct a right turn.

To rotate the sail plug, follow the procedure previously described.

After rotating the plug in the desired amount in the desired direction, (see above) tighten the screw to secure the plug against rotation. When the screw is properly tightened, there will be a slight bulge (less than or equal to the wall thickness of the tube) in the rear leading edge tube adjacent to the screw.

Batten tension

All battens are tensioned by looping the batten string over the notched end of the batten twice. The inboard batten strings should be slightly on the loose side. You should be able to pull the string about 3/8" beyond

the end of the batten tip, and when the string is set onto the tip the tension along the batten pocket should be just enough to pull most of the static wrinkles out of the sail, but not so tight as to cause the batten camber to push upwards causing a bulge in the sail. The outboard batten strings should be progressively tighter as you go towards the tip. The number one batten strings should be quite tight, and when they are properly adjusted you will not be able to install them unless the crossbar is tensioned.

Leading edge sail tension

The tension in the leading edge of the sail, adjustable by shimming as described above, will influence the performance and handling of the glider. If the sail is mounted too loose, the performance will deteriorate noticeably. If the sail is mounted too tight, the glider will handle poorly; it will be stiff and slow in roll response with excessive adverse yaw. As the glider gets older and the sail stretches, you will need to add shims to maintain the proper tension.

Car Top Mounting and Transport

Improper or careless transport of your glider can cause significant damage. You should transport your glider on a rack which has at least three support points which span at least 13' of the length of the glider. These should be well padded and at least four inches wide to distribute the load. Your glider should be mounted on your rack with the control bar facing down (glider bag zipper down) to provide an extra measure of protection for the crossbar. It should be securely tied down with webbing straps which are at least 1/2" wide, but not tied so tightly or with such a small diameter rope that the mylar insert is permanently deformed. If you drive on rough roads where the glider receives impact loads, you should take extra care to pad your glider internally when you pack it up. One special area to pay attention to is the forward area of the glider where the crossbar center section bears against the top of the leading edge and keel tubes. Some extra padding inserted in this area will save wear on your airframe and sail.

In Closing

With proper care and maintenance, your glider will retain a high level of airworthiness for some years. Because of the relatively short history of hang gliding, and the rapid advances in new designs, we do not have a lot of information about the ultimate service life of a hang glider. We do know that ultraviolet (UV) damage to the sail from sunlight is probably the limiting factor in the life of your sail. Try to avoid exposing your sail to sunlight any time you are not actually flying it.

We also know that there are forces in nature which can be so violent that they can result in fatal accidents regardless of the airworthiness of your aircraft. Ultimately your safety is your responsibility. Know the limitations of your knowledge, skill and experience, and know the limitations of your aircraft. Fly within those limitations.

Have fun.

See you in the sky!

Wills Wing, Inc.

HGMA AIRWORTHINESS STANDARDS

HGMA Fusion 150 COMPLIANCE VERIFICATION SPECIFICATION SHEET

GLIDER MODEL: Fusion 150

MANUFACTURED BY: Wills Wing, Inc.

All dimensions in inches; weights in pounds.

NOTE: These specifications are intended only as a guideline for determining whether a given glider is a certifIed model and whether it is in the certified configuration. Be aware, however, that no set of specifications, however detailed, can guarantee the ability to determine whether a glider is the same model, or is in the same configuration as was certified, or has those performance, stability, and structural characteristics required by the certification standards. An owner's manual is required to be delivered with each HGMA certified glider, and it is required that it contain additional airworthiness information.

1. Weight of glider with all essential parts and without coverbags and non-essential parts: 76
2. Leading Edge Dimensions
   a. Nose plate anchor hole to:
      1. Crossbar attachment hole 127.0
      2. Rear sail attachment point 221.63 - 222.48
   b. Outside diameter at:
      1. Nose 2.44
      2. Crossbar 2.44
      3. Rear sail attachment point 1.97
3. Crossbar Dimensions
   a. Overall pin to pin length from cam lever bracket attachment point on leading edge to load bearing pin at xbar plate 116.0 - 116.625
   b. Largest outside dimension 3.25 top to bottom
4. Keel dimensions; least and greatest allowable distances, whether variable through tuning or through in-flight variable geometry, from the line joining the leading edge nose bolts to:
   a. The xbar center load bearing pin 34.75 - 36.0
   b. The pilot hang loop 50.75 - 53.25
5. Sail Dimensions
   a. Chord lengths at
      1. 3 ft outboard of centerline 65
      2. 3 ft inboard of tip 41
   b. Span (extreme tip to tip) 406 inc tip fairings (VGT)
6. Location of Information Placard Keel
   Location of Test Fly Sticker Keel
7. Recommended Pilot Weight Range 165 - 275
8. Recommended Pilot Proficiency USHGA Advanced

HGMA AIRWORTHINESS STANDARDS

HGMA Fusion 141 COMPLIANCE VERIFICATION SPECIFICATION SHEET

GLIDER MODEL: Fusion 141

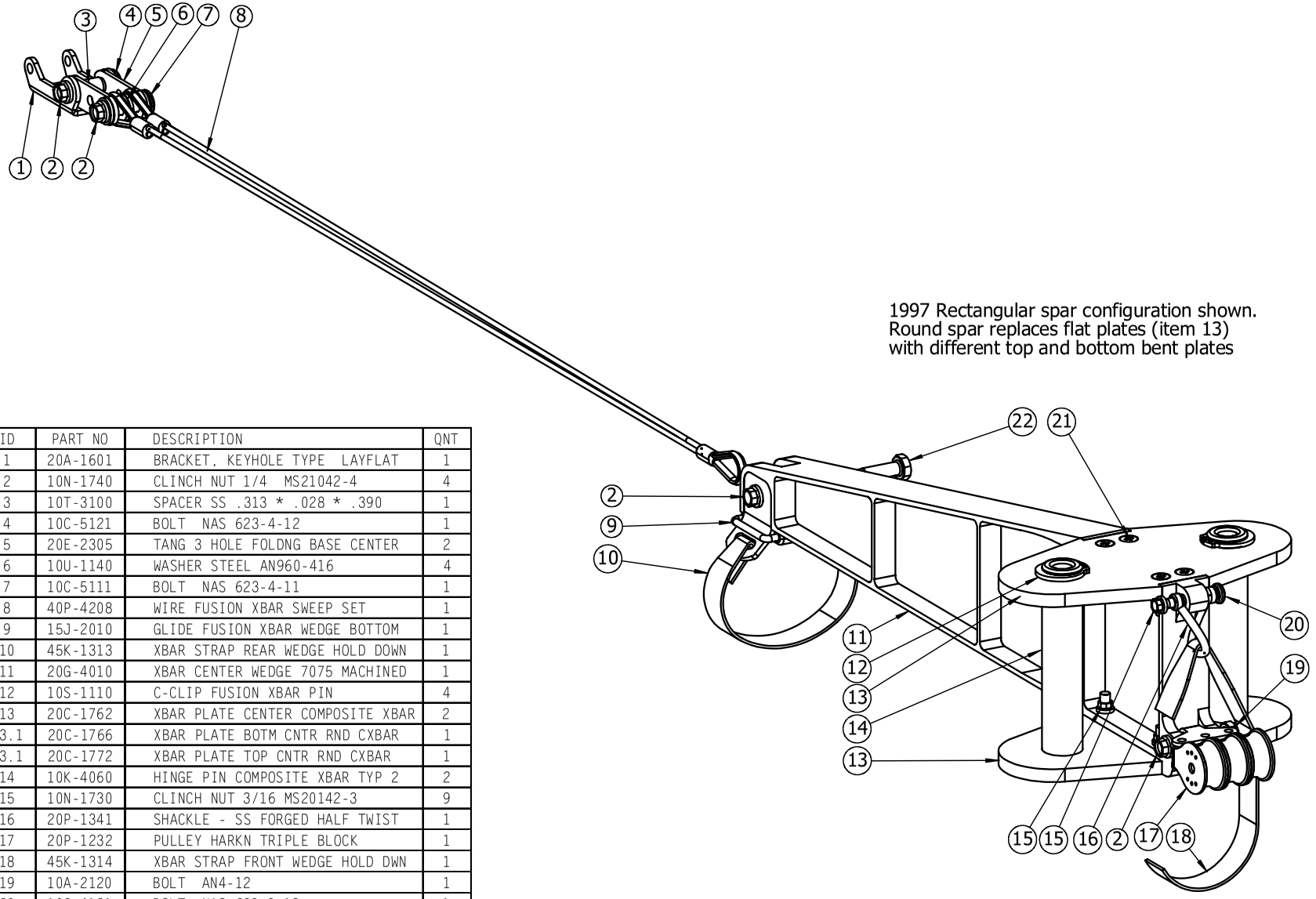
MANUFACTURED BY: Wills Wing, Inc.

All dimensions in inches; weights in pounds.

NOTE: These specifications are intended only as a guideline for determining whether a given glider is a certifIed model and whether it is in the certified configuration. Be aware, however, that no set of specifications, however detailed, can guarantee the ability to determine whether a glider is the same model, or is in the same configuration as was certified, or has those performance, stability, and structural characteristics required by the certification standards. An owner's manual is required to be delivered with each HGMA certified glider, and it is required that it contain additional airworthiness information.

1. Weight of glider with all essential parts and without coverbags and non-essential parts: 74
2. Leading Edge Dimensions
   a. Nose plate anchor hole to:
      1. Crossbar attachment hole 122.0
      2. Rear sail attachment point 214.63 - 215.38
   b. Outside diameter at:
      1. Nose 2.44
      2. Crossbar 2.44
      3. Rear sail attachment point 1.97
3. Crossbar Dimensions
   a. Overall pin to pin length from cam lever bracket attachment point on leading edge to load bearing pin at xbar plate 111.38 - 112.0
   b. Largest outside dimension 3.25 top to bottom
4. Keel dimensions; least and greatest allowable distances, whether variable through tuning or through in-flight variable geometry, from the line joining the leading edge nose bolts to:
   a. The xbar center load bearing pin 32.25 - 33.5
   b. The pilot hang loop 49.25 - 52.75
5. Sail Dimensions
   a. Chord lengths at
      1. 3 ft outboard of centerline 63.75
      2. 3 ft inboard of tip 39.5
   b. Span (extreme tip to tip) 390.5 VGL, 392.75 VGT, inc tip fairings
6. Location of Information Placard Keel
   Location of Test Fly Sticker Keel
7. Recommended Pilot Weight Range 145 - 235
8. Recommended Pilot Proficiency USHGA Advanced

Contents



ID	PART NO	DESCRIPTION	QNT
1	20A-1601	BRACKET, KEYHOLE TYPE LAYFLAT	1
2	10N-1740	CLINCH NUT 1/4 MS21042-4	4
3	10T-3100	SPACER SS .313 * .028 * .390	1
4	10C-5121	BOLT NAS 623-4-12	1
5	20E-2305	TANG 3 HOLE FOLDNG BASE CENTER	2
6	10U-1140	WASHER STEEL AN960-416	4
7	10C-5111	BOLT NAS 623-4-11	1
8	40P-4208	WIRE FUSION XBAR SWEEP SET	1
9	15J-2010	GLIDE FUSION XBAR WEDGE BOTTOM	1
10	45K-1313	XBAR STRAP REAR WEDGE HOLD DOWN	1
11	20G-4010	XBAR CENTER WEDGE 7075 MACHINED	1
12	10S-1110	C-CLIP FUSION XBAR PIN	4
13	20C-1762	XBAR PLATE CENTER COMPOSITE XBAR	2
13.1	20C-1766	XBAR PLATE BOTM CNTR RND CXBAR	1
13.1	20C-1772	XBAR PLATE TOP CNTR RND CXBAR	1
14	10K-4060	HINGE PIN COMPOSITE XBAR TYP 2	2
15	10N-1730	CLINCH NUT 3/16 MS20142-3	9
16	20P-1341	SHACKLE - SS FORGED HALF TWIST	1
17	20P-1232	PULLEY HARKN TRIPLE BLOCK	1
18	45K-1314	XBAR STRAP FRONT WEDGE HOLD DWN	1
19	10A-2120	BOLT AN4-12	1
20	10C-4121	BOLT NAS 623-3-12	1
21	10C-1051	BOLT NAS 517-3-5	8
22	10A-2120	BOLT AN4-12	1

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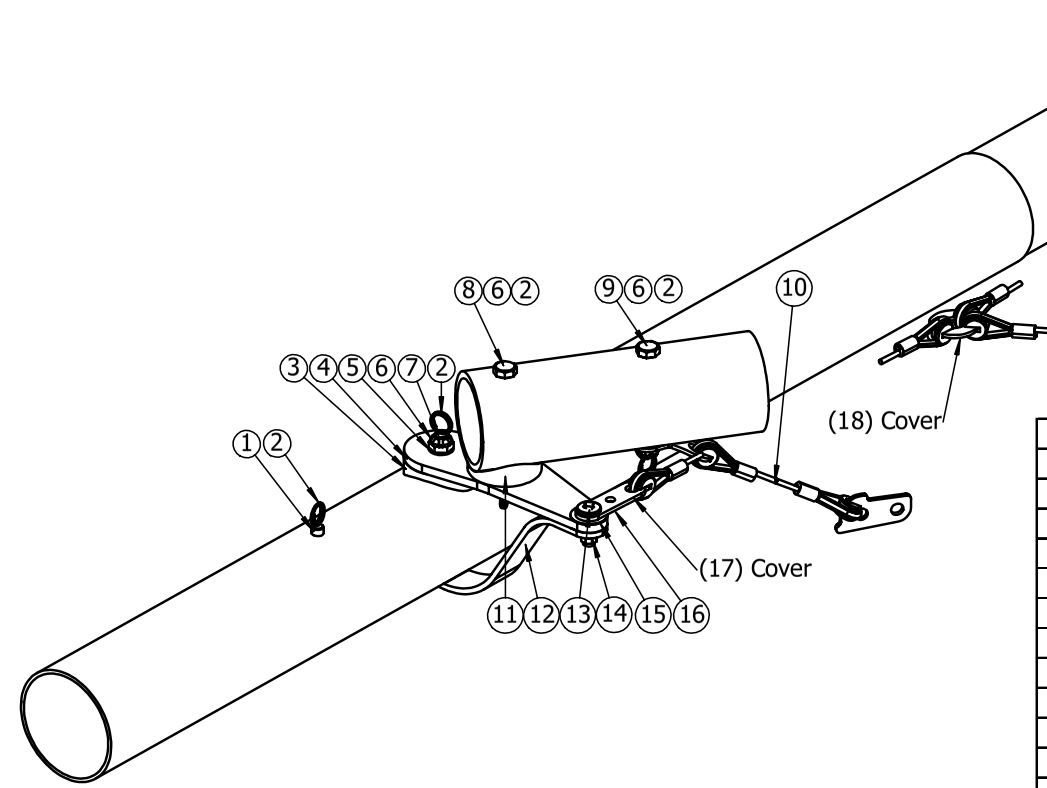
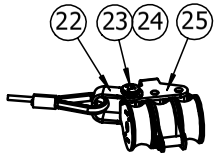
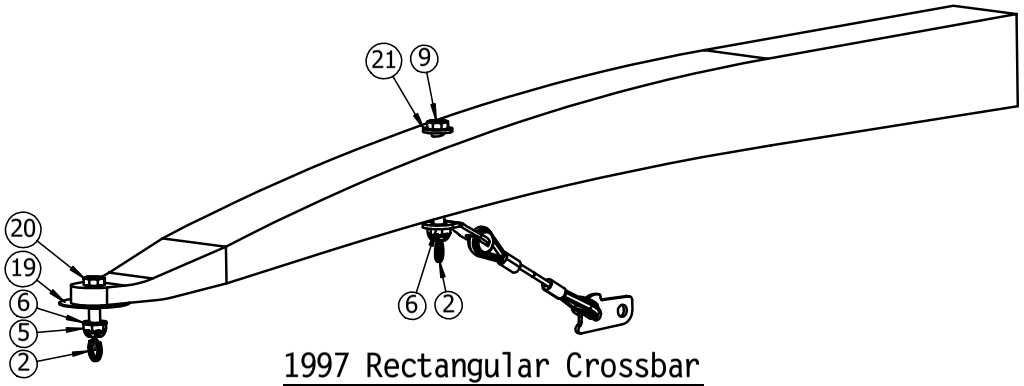
TITLE: **Fusion Crossbar Center**

Document ID:	DWG ID:	DATE:	REVISED:	BY:
83E01.1	Xbar Plate Center.DRW	04-07-97	12-15-97	Pearson







1997 Rectangular Crossbar

ID	PART NO	DESCRIPTION	QNT
1	10G-2790	CLEVIS PIN MS20392-3C79	2
2	10P-1100	SAFETY RING AN 9491 SMALL	8
3	15F-6201	SADDLE, 62mm POLYCARB	4
4	20C-1751	XBAR PLATE CAM VG LEVER	2
5	10U-1141	WASHER STEEL AN960-416L	2
6	10N-1340	CASTLENUT 1/4 AN310-4	6
7	10B-2520	BOLT AN24-52	2
8	10A-2260	BOLT AN4-26	2
9	10A-2240	BOLT AN4-24	2
10	40P-3104	WIRE BOTTOM SIDE 1/8 AT STYLE	2
11	15D-2001	SADDLE 2	2
12	20C-1752	XBAR PLATE SUPPORT STRAP CAM VG	2
13	10C-5071	BOLT NAS 623-4-7	2
14	10N-1740	CLINCH NUT 1/4 MS21042-4	2
15	10U-5125	WASHER NYLON .75 * .316 * .020	2
16	40P-5100	WIRE VG CAM LEVER ASSY	2
17	45G-3066	COVER NEOPRENE FUSION CAM VG WIRE	2
18	45G-3069	COVER NEOPRN CAM VG CABL JNCT	2
19	10U-5240	WASHER NYLON 1.50 * .250 * .02	2
20	10A-2100	BOLT AN4-10	2
21	10U-1400	WASHER MS 15795-210	2
22	20P-1331	SHACKLE - SS HARKN MICRO BLOCK	2
23	10L-1052	SCREW MS27039-0812	2
24	10N-1220	LOCKNUT LOWPRO 0832 SS	2
25	20P-1234	PULLEY HARKN TRIPLE BLK BCKT MFD	1
NS	15C-6219	ENDCAP 62mm OD 58.2 ID	2

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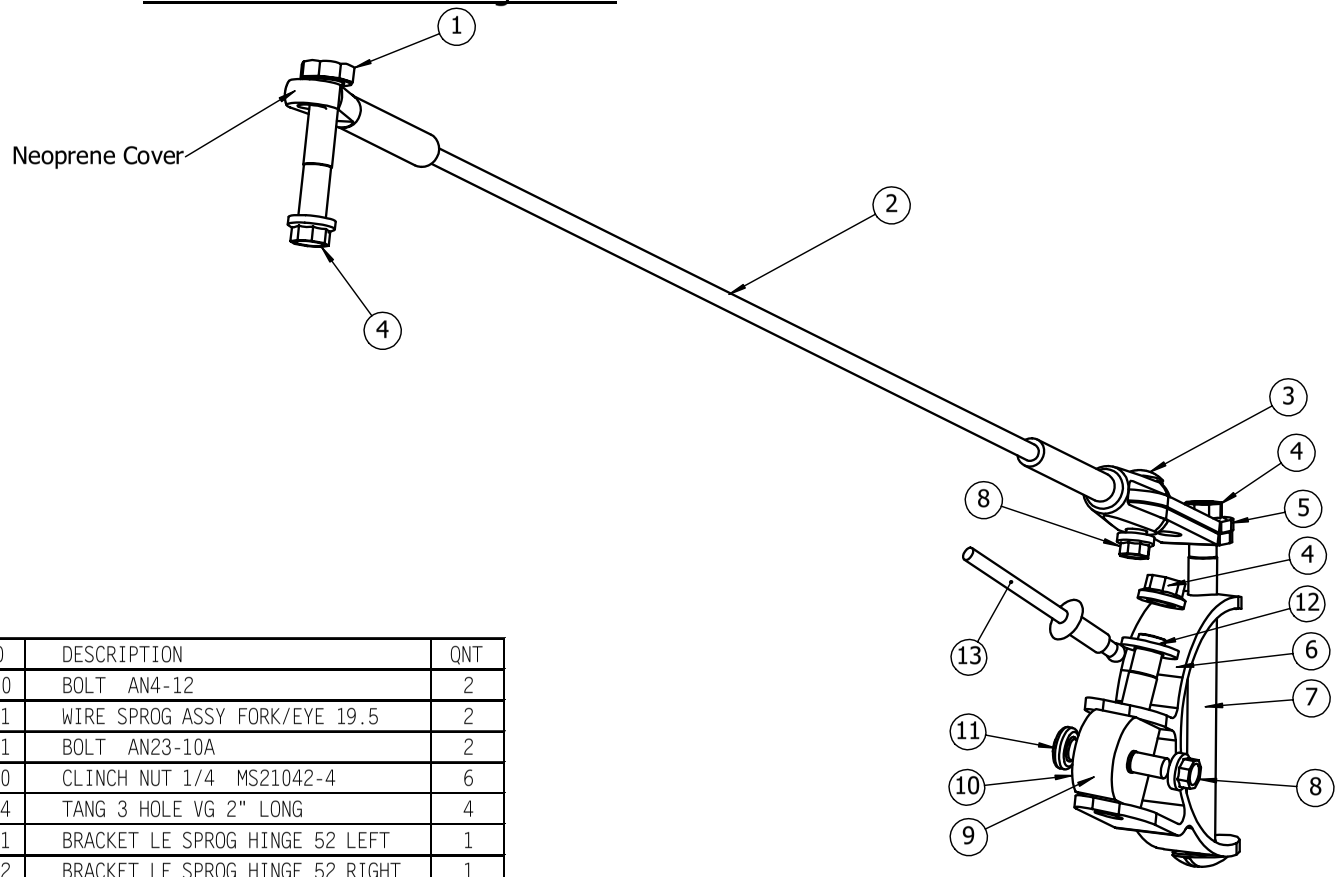
TITLE: **Fusion Front Leading Edge and Cam VG**

Document ID:	DWG ID:	DATE:	REVISED:	BY:
83E02.2	Fusion FLE.DRW	04-07-97	10-15-98	Pearson

Note:
See 83E10 'Fusion Aluminum Sprog and Hardware Assembly'
for Current Model Configuration



ID	PART NO	DESCRIPTION	QNT
1	10A-2120	BOLT AN4-12	2
2	40P-6001	WIRE SPROG ASSY FORK/EYE 19.5	2
3	10B-1101	BOLT AN23-10A	2
4	10N-1740	CLINCH NUT 1/4 MS21042-4	6
5	20E-2304	TANG 3 HOLE VG 2" LONG	4
6	20G-2451	BRACKET LE SPROG HINGE 52 LEFT	1
6	20G-2452	BRACKET LE SPROG HINGE 52 RIGHT	1
7	10B-2400	BOLT AN24-40	2
8	10N-1730	CLINCH NUT 3/16 MS20142-3	4
9	10B-2201	BOLT AN24-20A	2
10	20G-2448	SPROG FORK HINGE PILLAR	2
11	10C-4081	BOLT NAS 623-3-8	2
12	10U-1140	WASHER STEEL AN960-416	2
13	10R-0366	RIVET AL 3/16 * .375 CHAAPQ6-4	2
NS	45G-3065	COVER NEOPRENE FUSION SPROG	2

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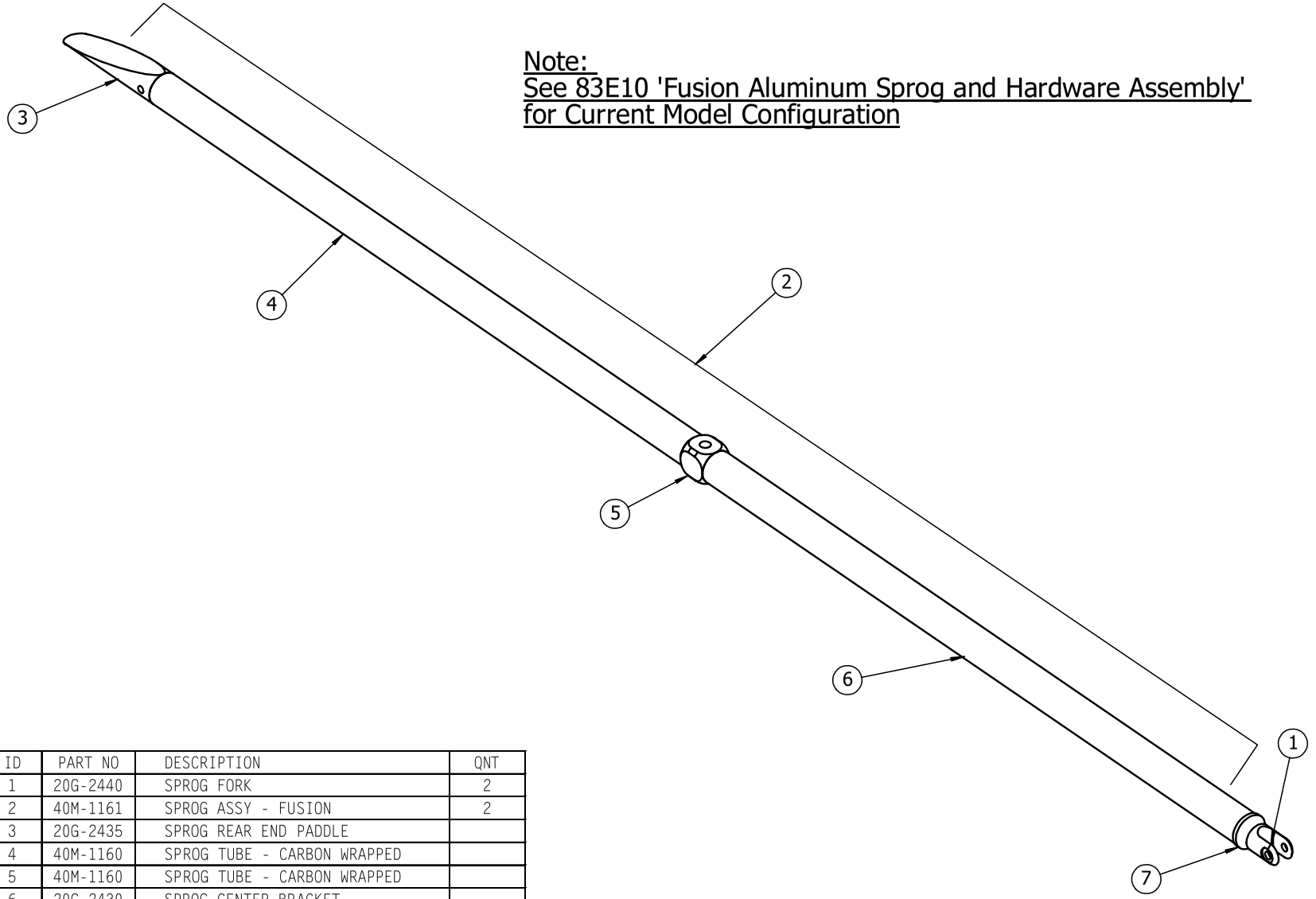
TITLE: **Fusion Sprog Wire and Bracket (Carbon Sprog)**

Document ID:	DWG ID:	DATE:	REVISED:	BY:
83E03.2	Sprog Wire and Bracket.DRW	04-07-97	10-15-98	Pearson

83E07.0 Fusion Sprog (Carbon)



Note:
See 83E10 'Fusion Aluminum Sprog and Hardware Assembly' for Current Model Configuration

ID	PART NO	DESCRIPTION	QNT
1	20G-2440	SPROG FORK	2
2	40M-1161	SPROG ASSY - FUSION	2
3	20G-2435	SPROG REAR END PADDLE	
4	40M-1160	SPROG TUBE - CARBON WRAPPED	
5	40M-1160	SPROG TUBE - CARBON WRAPPED	
6	20G-2430	SPROG CENTER BRACKET	
7	20G-2445	SPROG FORK THREADED ADJUSTER	

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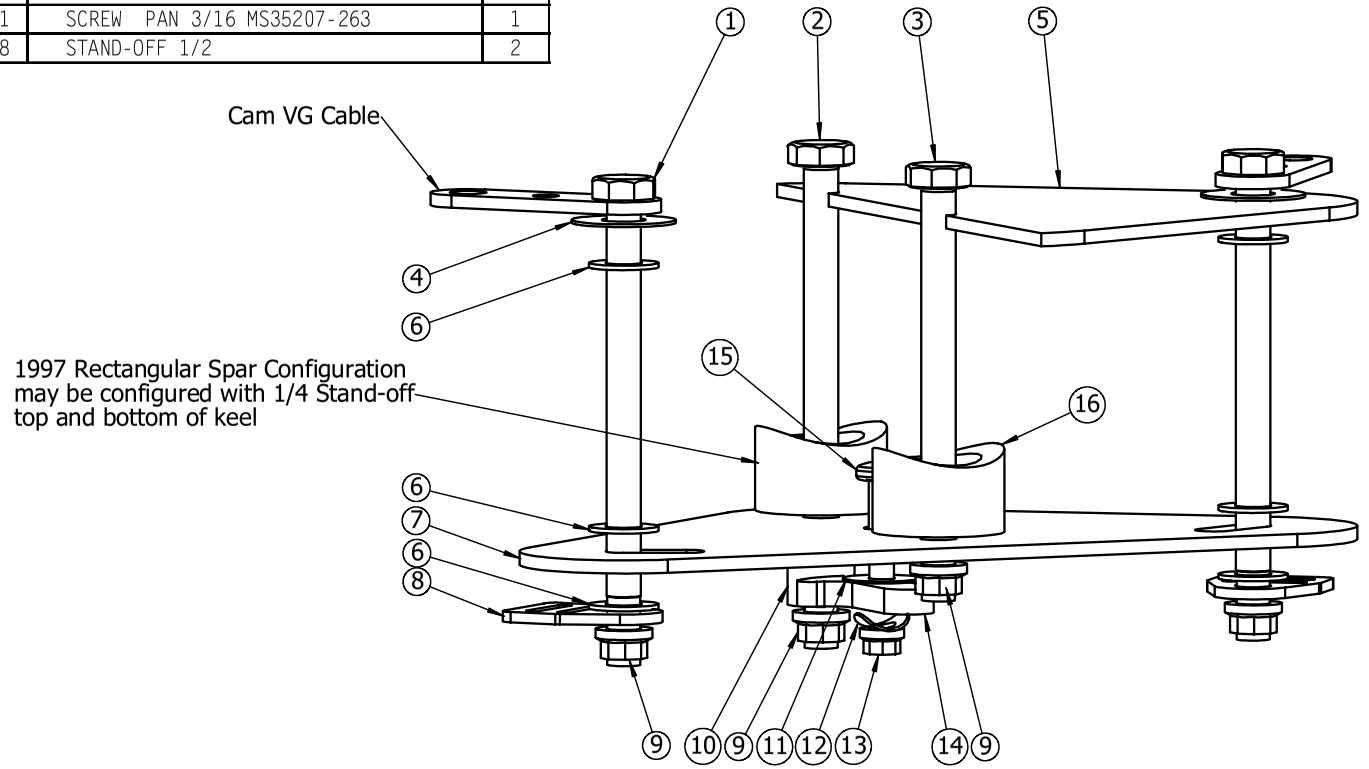
TITLE: **Sprog**

Document ID:	DWG ID:	DATE:	REVISED:	BY:
83E07.0	Sprog.DRW	04-07-97	06-10-97	Pearson

T.U.S. .X ± .05
.XX ± .015
.XXX ± .003
.XXXX ± .0005
ANGLES ± 1/2°

ID	PART NO	DESCRIPTION	QNT
1	10A-2321	BOLT AN4-32A	2
2	10A-2341	BOLT AN4-34A	1
3	10A-2301	BOLT AN4-30A	1
4	10U-5125	WASHER NYLON .75 * .316 * .020	2
5	20C-1621	NOSEPLATE RAMAIR TOP EXTENDED	1
6	10U-1141	WASHER STEEL AN960-416L	6
7	20C-1631	NOSEPLATE FUSION BOTTOM SLOTTED	1
8	20E-2321	TANG 1 HOLE 2 SLOT 5/8 WEBBING	2
9	10N-1740	CLINCH NUT 1/4 MS21042-4	4
10	20G-2901	COLLAR KEYHOLE TANG BOLT	1
11	10U-5093	WASHER NYLON .560 *.192 *.015	1
12	10U-8010	WASHER WAVE KEYHOLE ANCHOR	1
13	10N-1730	CLINCH NUT 3/16 MS20142-3	1
14	20C-1501	SAFETY ALUM KEYHOLE ANCHOR	1
15	10L-1061	SCREW PAN 3/16 MS35207-263	1
16	15F-1608	STAND-OFF 1/2	2



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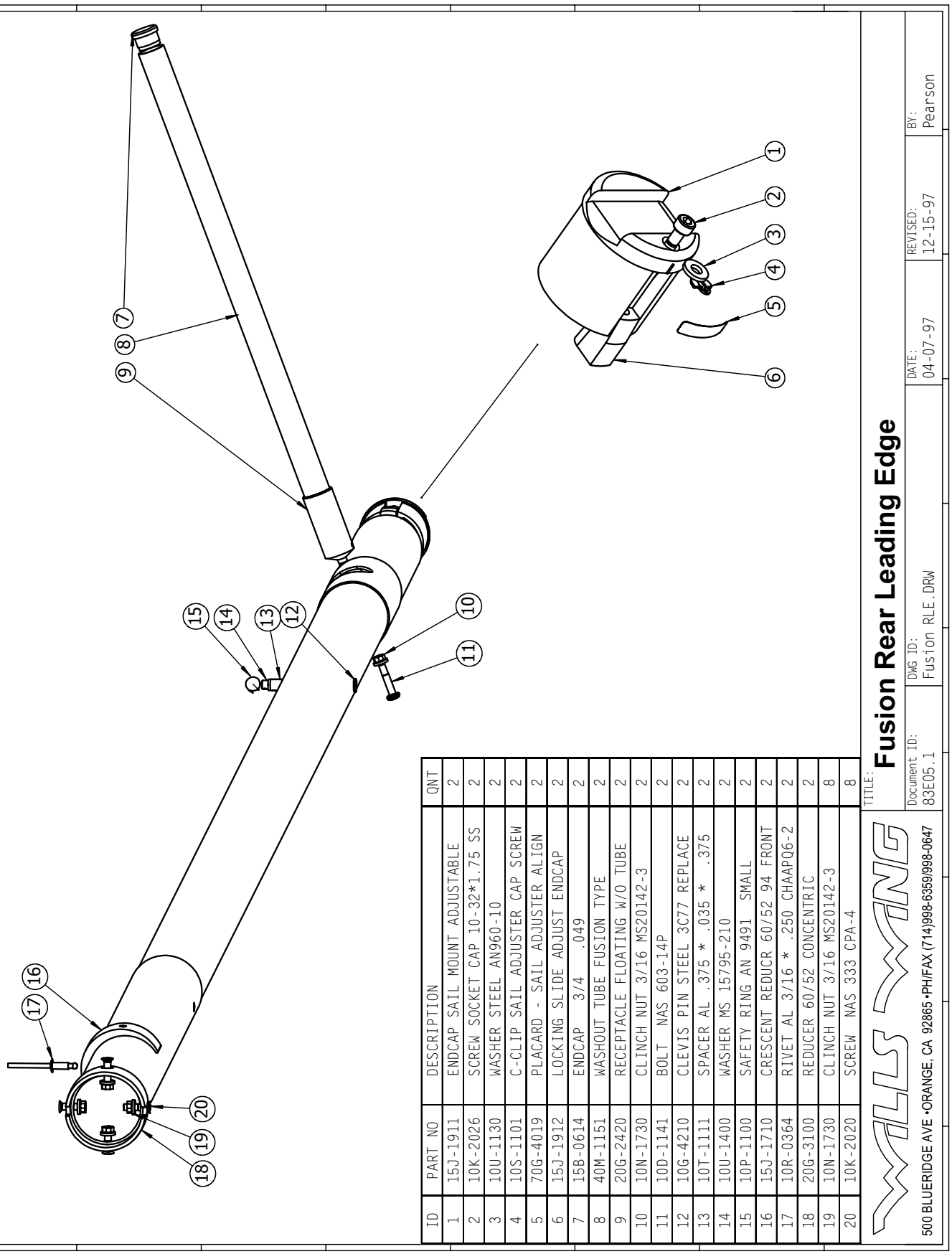
TITLE: **Fusion Noseplate**

Document ID:	DWG ID:	DATE:	REVISED:	BY:
83E04.1	Noseplate.DRW	04-07-97	12-15-97	Pearson



ID	PART NO	DESCRIPTION	QNT
1	15J-1911	ENDCAP SAIL MOUNT ADJUSTABLE	2
2	10K-2026	SCREW SOCKET CAP 10-32*1.75 SS	2
3	10U-1130	WASHER STEEL AN960-10	2
4	10S-1101	C-CLIP SAIL ADJUSTER CAP SCREW	2
5	70G-4019	PLACARD - SAIL ADJUSTER ALIGN	2
6	15J-1912	LOCKING SLIDE ADJUST ENDCAP	2
7	15B-0614	ENDCAP 3/4 .049	2
8	40M-1151	WASHOUT TUBE FUSION TYPE	2
9	20G-2420	RECEPTACLE FLOATING W/O TUBE	2
10	10N-1730	CLINCH NUT 3/16 MS20142-3	2
11	10D-1141	BOLT NAS 603-14P	2
12	10G-4210	CLEVIS PIN STEEL 3C77 REPLACE	2
13	10T-1111	SPACER AL .375 * .035 * .375	2
14	10U-1400	WASHER MS 15795-210	2
15	10P-1100	SAFETY RING AN 9491 SMALL	2
16	15J-1710	CRESCENT REDUCR 60/52 94 FRONT	2
17	10R-0364	RIVET AL 3/16 * .250 CHAAPQ6-2	2
18	20G-3100	REDUCER 60/52 CONCENTRIC	2
19	10N-1730	CLINCH NUT 3/16 MS20142-3	8
20	10K-2020	SCREW NAS 333 CPA-4	8

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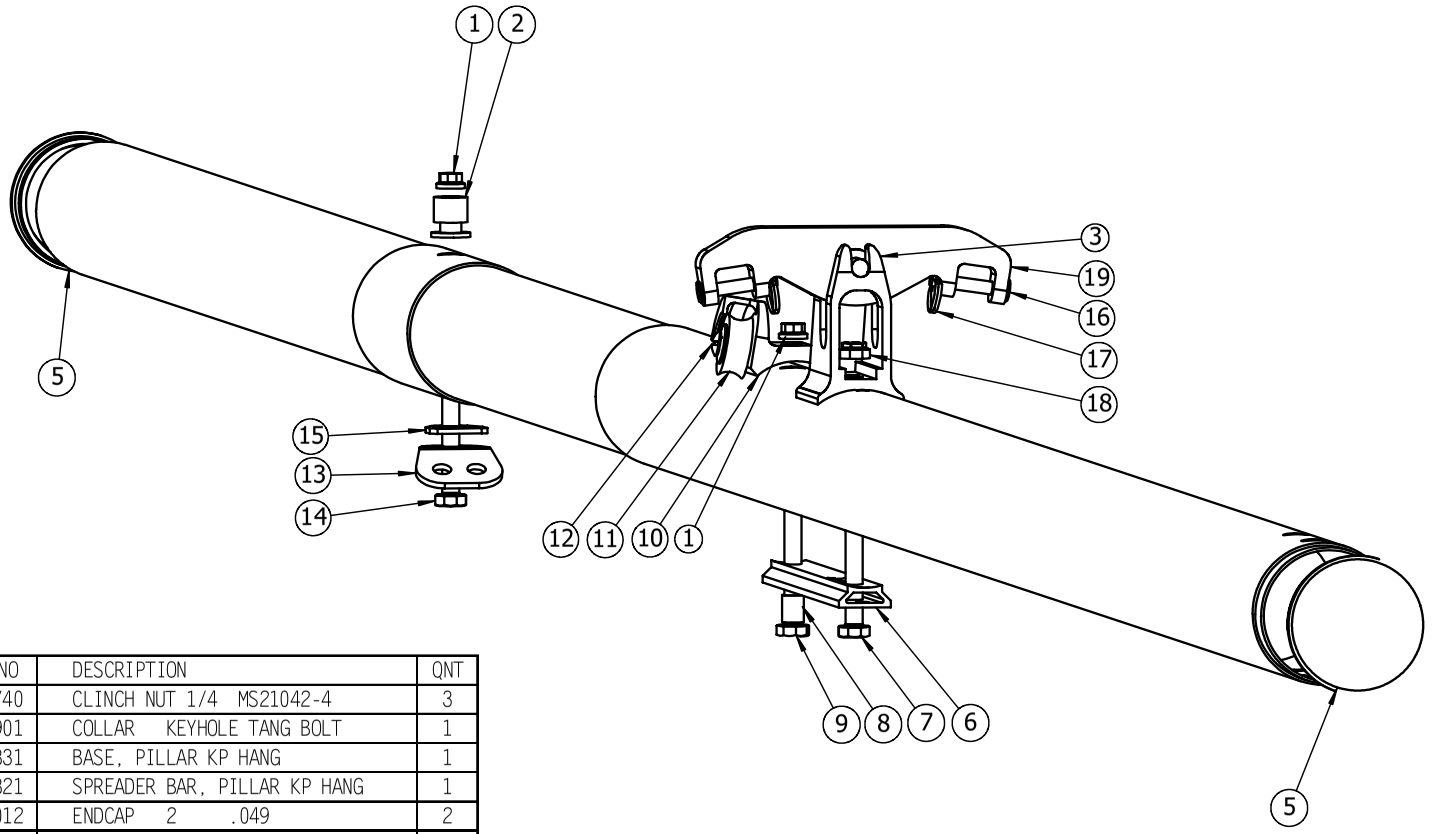
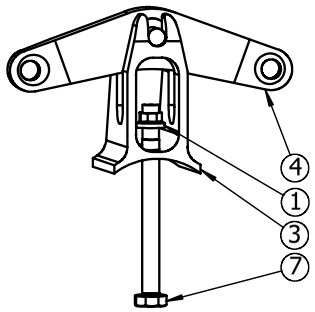
TITLE: **Fusion Rear Leading Edge**

Document ID: 83E05.1 | DWG ID: Fusion RLE.DRW | DATE: 04-07-97 | REVISED: 12-15-97 | BY: Pearson

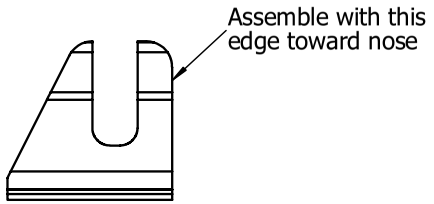
83E05.1 Fusion Rear Leading Edge



ID	PART NO	DESCRIPTION	QNT
1	10N-1740	CLINCH NUT 1/4 MS21042-4	3
2	20G-2901	COLLAR KEYHOLE TANG BOLT	1
3	20G-2831	BASE, PILLAR KP HANG	1
4	20G-2821	SPREADER BAR, PILLAR KP HANG	1
5	15B-2012	ENDCAP 2 .049	2
6	20G-2104	TRACK LAYFLAT CBAR APEX FUSION	1
7	10A-2251	BOLT AN4-25A	1
8	10T-3100	SPACER SS .313 * .028 * .390	1
9	10A-2321	BOLT AN4-32A	1
10	20G-1510	BRACKET VG PULLEY KEEL MOUNT	1
11	20P-1230	PULLEY HARKN SHEAVE TOP LEG VG	1
12	10B-1101	BOLT AN23-10A	1
13	40P-3301	WIRE SET BOTTOM REAR BALL SWDG	1
14	10A-2311	BOLT AN4-31A	1
15	20E-2321	TANG 1 HOLE 2 SLOT 5/8 WEBBING	1
16	10G-1310	CLEVIS PIN MS20392-2C31	2
17	10P-1100	SAFETY RING AN 9491 SMALL	2
18	10N-1540	FLEXLOC 1/4 LOWPRO AN21FK-428	1
19	20G-2822	SPREADER BAR, PILLAR HANG / WEB	1



Early 1997 Perlon Hang T



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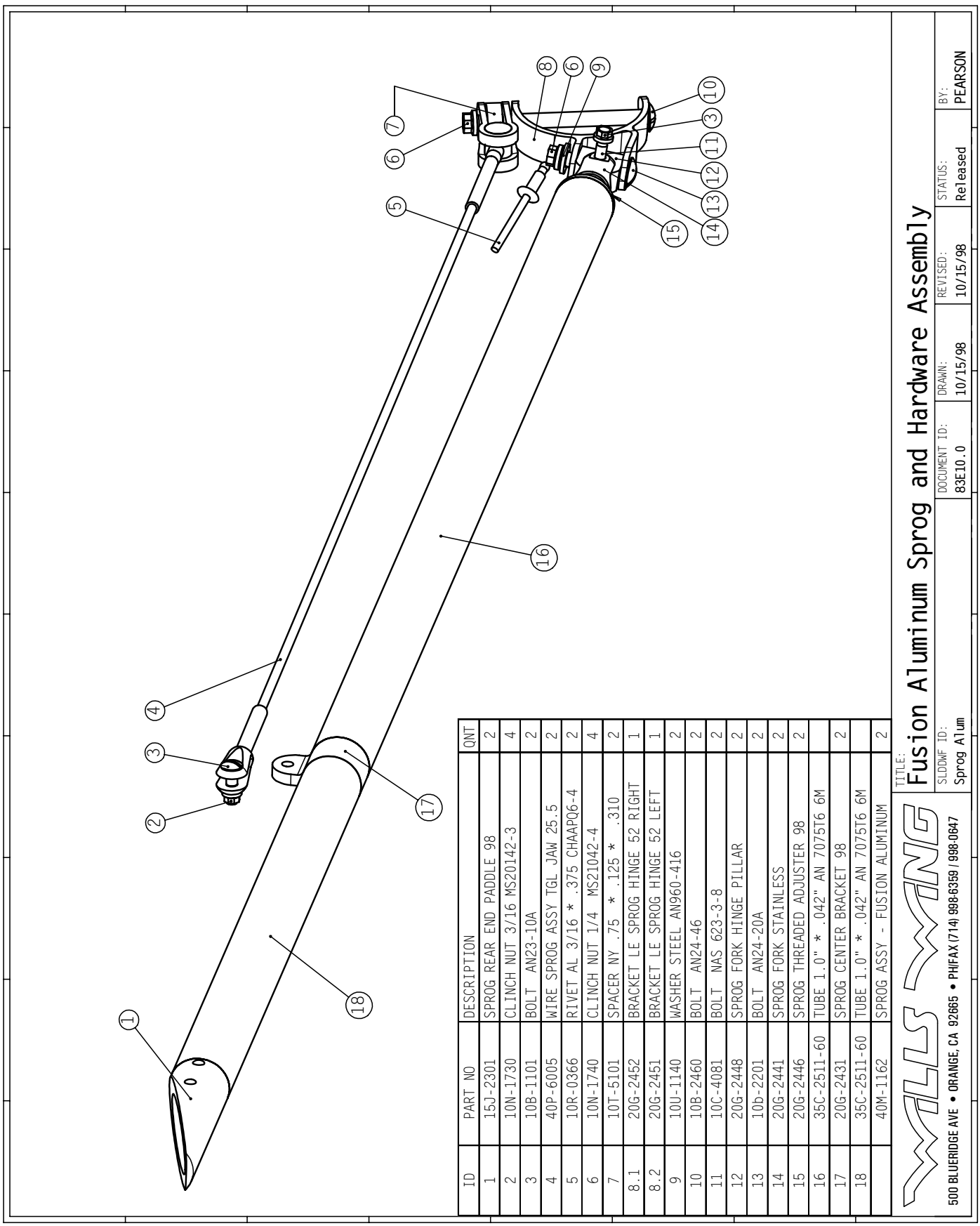
TITLE: **Fusion Keel**

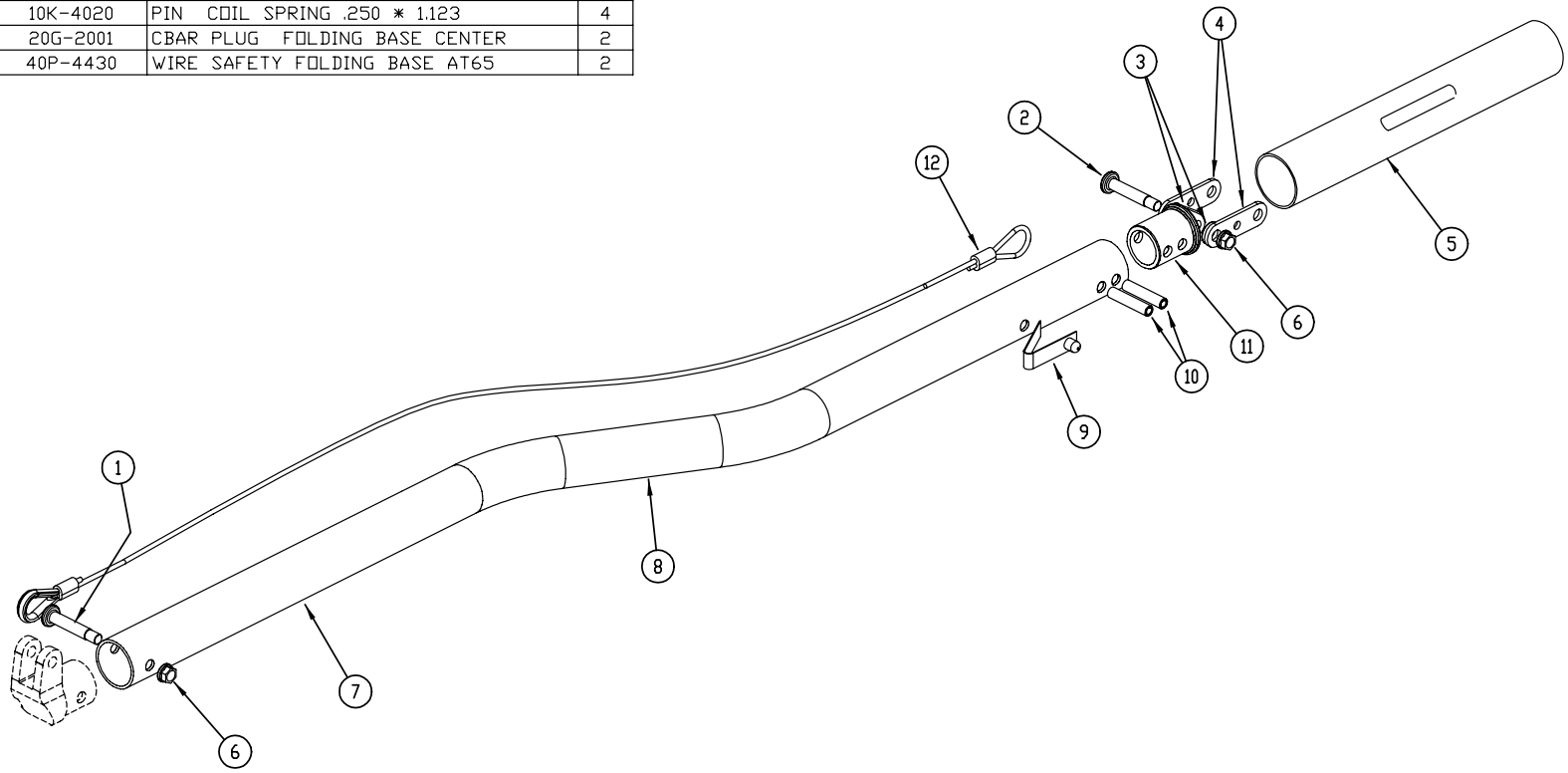
Document ID:	DWG ID:	DATE:	REVISED:	BY:
83E06.1	Fusion Keel.DRW	04-07-97	12-15-97	Pearson



ID	PART NO	DESCRIPTION	QNT
1	15J-2301	SPROG REAR END PADDLE 98	2
2	10N-1730	CLINCH NUT 3/16 MS20142-3	4
3	10B-1101	BOLT AN23-10A	2
4	40P-6005	WIRE SPROG ASSY TGL JAW 25.5	2
5	10R-0366	RIVET AL 3/16 * .375 CHAAPQ6-4	2
6	10N-1740	CLINCH NUT 1/4 MS21042-4	4
7	10T-5101	SPACER NY .75 * .125 * .310	2
8.1	20G-2452	BRACKET LE SPROG HINGE 52 RIGHT	1
8.2	20G-2451	BRACKET LE SPROG HINGE 52 LEFT	1
9	10U-1140	WASHER STEEL AN960-416	2
10	10B-2460	BOLT AN24-46	2
11	10C-4081	BOLT NAS 623-3-8	2
12	20G-2448	SPROG FORK HINGE PILLAR	2
13	10b-2201	BOLT AN24-20A	2
14	20G-2441	SPROG FORK STAINLESS	2
15	20G-2446	SPROG THREADED ADJUSTER 98	2
16	35C-2511-60	TUBE 1.0" * .042" AN 7075T6 6M	
17	20G-2431	SPROG CENTER BRACKET 98	2
18	35C-2511-60	TUBE 1.0" * .042" AN 7075T6 6M	
	40M-1162	SPROG ASSY - FUSION ALUMINUM	2

83E10.0 Fusion Aluminum Sprog and hardware Assembly

ID	PART NO	DESCRIPTION	QNT
1	10C-5171	BOLT NAS 623-4-17	2
2	10C-5071	BOLT NAS 623-4-7	2
3	10U-5095	WASHER NYLON .560 *.320 *.013	4
4	20E-2305	TANG 3 HOLE FOLDNG BASE CENTER	2
5	40F-1391	SLEEVE FOLDING BASETUBE CENTER	1
6	10N-1740	CLINCH NUT 1/4 MS21042-4	4
7	40F-1342	BASETUBE HALF AT68 FOLDING SPD	2
ITEM NO.7 40F-1342 ARE ASSEMBLIES WITH NO USER SERVICABLE PARTS. COMPONENT PARTS ARE LISTED BELOW			
8	15A-1401	GRIP BASETUBE POLYFOAM	2
9	20A-1502	BUTTON SPRING DOUBLE	2
10	10K-4020	PIN COIL SPRING .250 * 1.123	4
11	20G-2001	CBAR PLUG FOLDING BASE CENTER	2
12	40P-4430	WIRE SAFETY FOLDING BASE AT65	2



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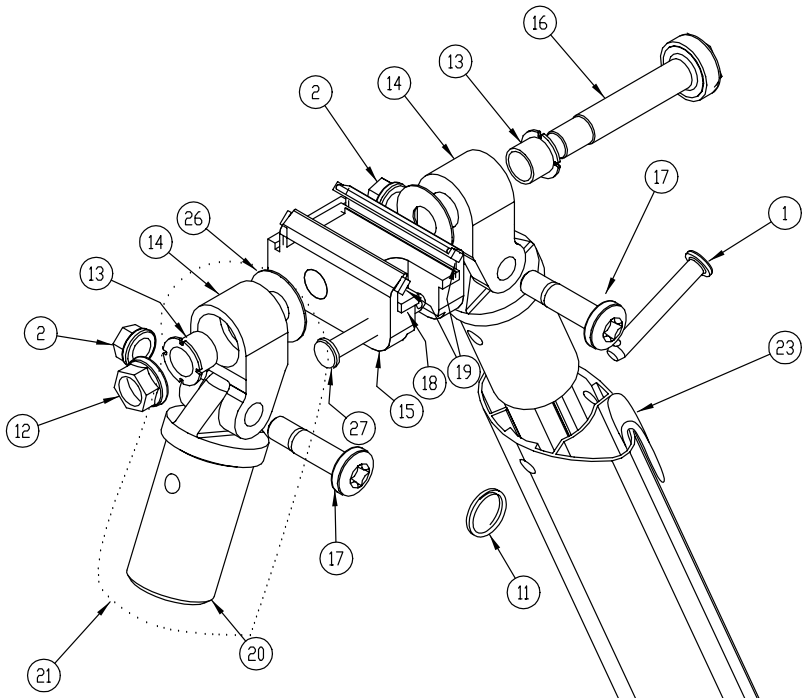
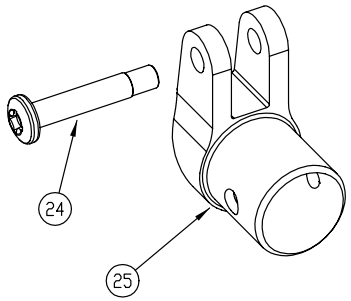
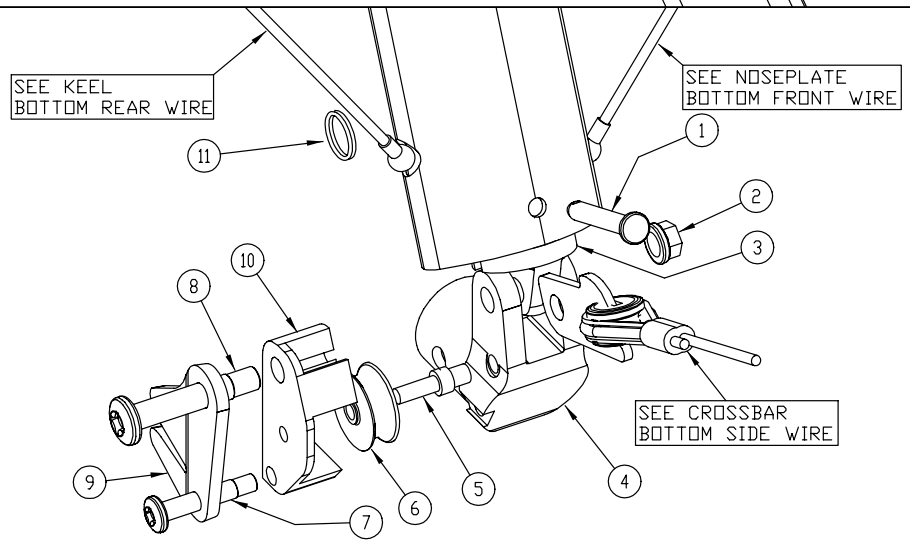
TITLE: VG FOLDING BASE TUBE

PART NO:	DWG ID:	DOCUMENT ID:	REVISED:	DRAWN:	SCALE:
NA	83E09.DWG	83E09.0	06-26-97 sp	01-15-96 sp	NA

T.U.S. .X ± .05
.XX ± .015
.XXX ± .003
.XXXX ± .0005
ANGLES ± 1/2°







ID	PART NO	DESCRIPTION	QNT
1	10G-1330	CLEVIS PIN MS20392-2C33	4
2	10N-1740	CLINCH NUT 1/4 MS21042-4	4
3	20G-1424	CBAR PLUG AT LEG BOT STR TOE95	2
4	20G-1802	CBAR BRACKET AT BASE END VG	1
5	10K-4040	PIN VG PULLEY SS MACHINED	1
6	20P-1220	PULLEY ALUM MACH CBAR BASE VG	1
7	10D-1161	BOLT NAS 603-16P	1
8	10C-5241	BOLT NAS 623-4-24	1
9	20C-1801	JAMCLEAT KNIFE V-CUT / ROPE VG	1
10	20G-1803	BRACKET BASE PULLEY ROPE VG	1
11	10P-1100	SAFETY RING AN 9491 SMALL	5
12	10N-1750	CLINCH NUT 5/16 MS21042-5	1
13	10T-5113	BUSH SPLIT HEADED AT CB SHORT	2
14	20G-1711	CBAR ELBOW AT TOP STREAM	2
15	20G-2203	SLIDER LAYFLAT CBAR APEX 3	1
16	10A-3201	BOLT AN5-20A GROUND & SLOTTED	1
17	10C-5111	BOLT NAS 623-4-11	2
18	15J-2003	GLIDE NOTCHED LAFLT APEX SLDR	1
19	15J-2002	GLIDE LAYFLAT APEX SLIDR SIDE	2
20	20G-1433	CBAR PLUG AT LEG TOP STR TOEIN	2
21	45G-3064	COVER NEOPRENE CB APEX RT VG	1
22	45G-3062	COVER NEOPRENE CBAR APEX LEFT	1
23	15A-1610	PROTECTOR VG ROPE - UHMW TAPE	1
24	10C-5121	BOLT NAS 623-4-12	1
25	20G-1801	CBAR BRACKET AT BASETUBE END	1
26	10U-5125	WASHER NYLON .75 * .316 * .020	2
27	10G-1370	CLEVIS PIN MS20392-2C37	1

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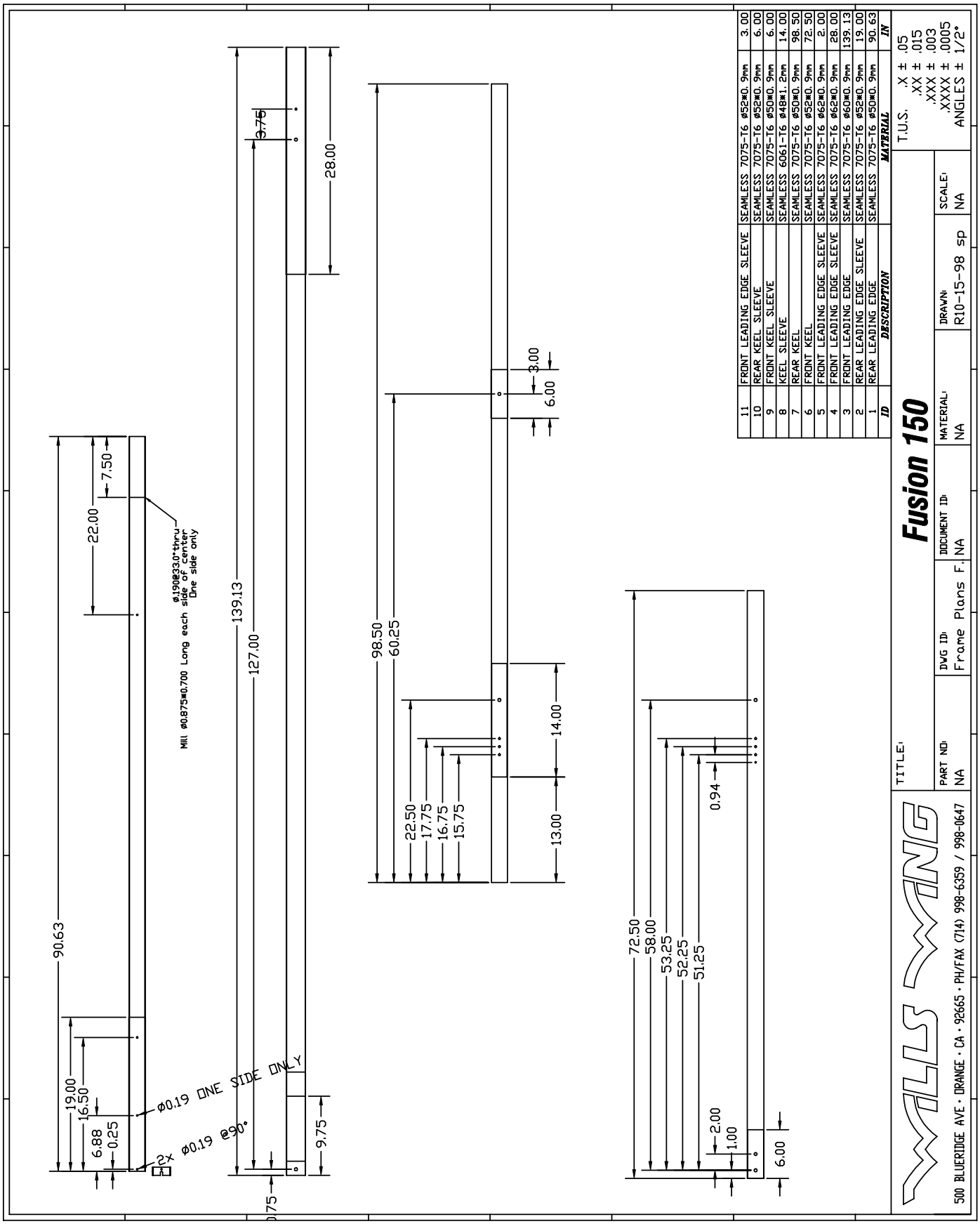
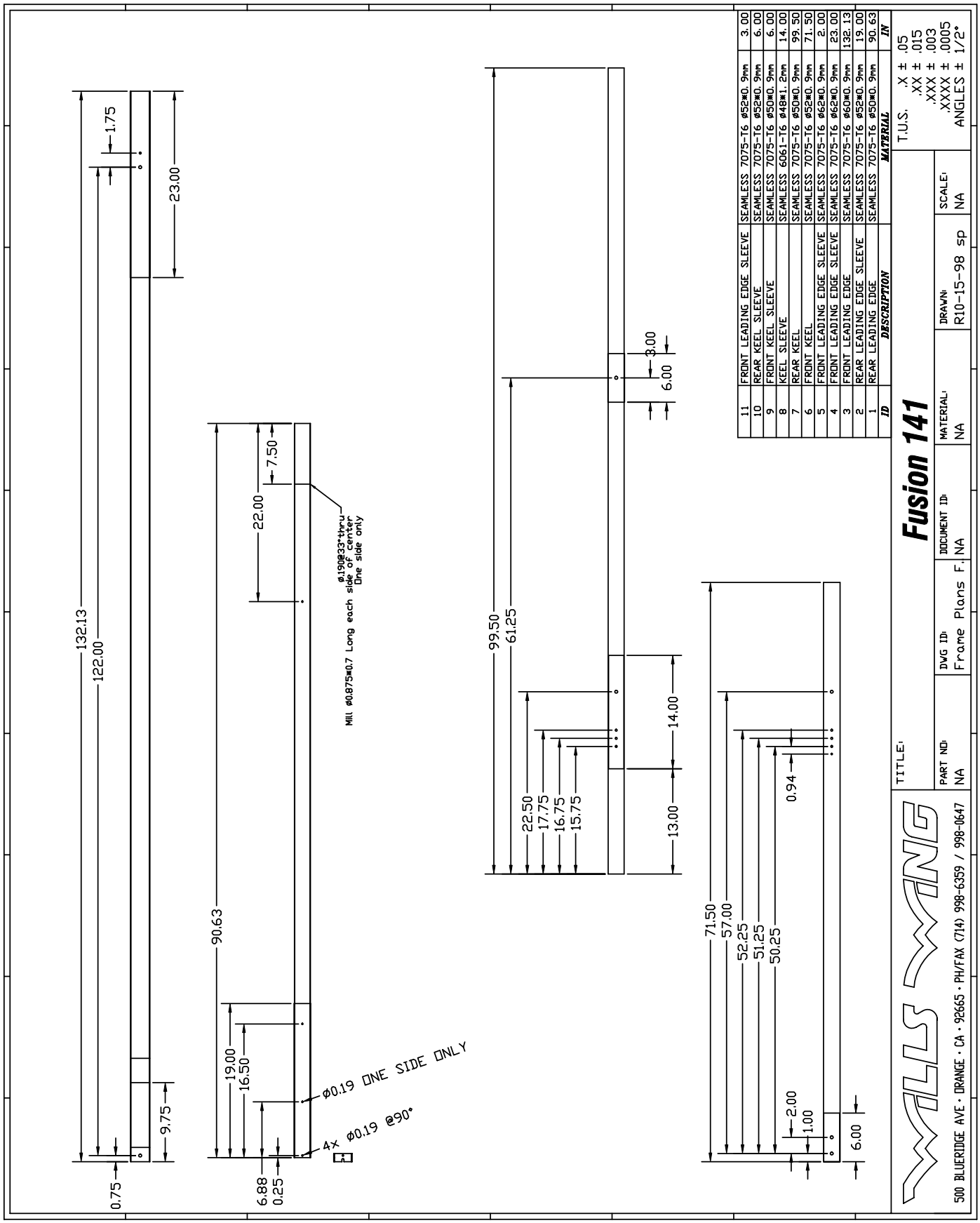
TITLE: VG CONTROL BAR

PART NO:	DWG ID:	DOCUMENT ID:	REVISED:	DRAWN:	SCALE:
NA	80E08.DWG	80E08.0	06-26-97	01-15-96 sp	NA

T.U.S. .X ± .05
.XX ± .015
.XXX ± .003
.XXXX ± .0005
ANGLES ± 1/2°

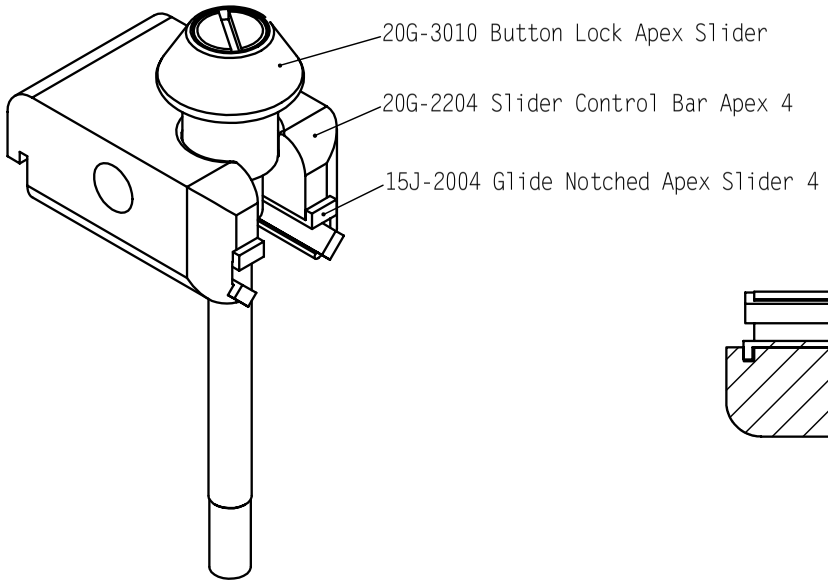


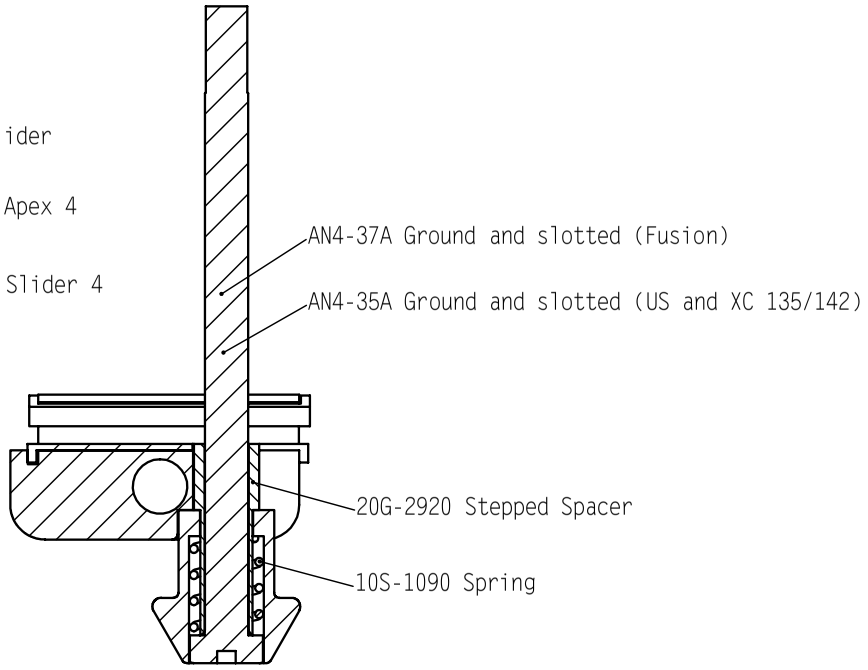
Fusion 150 Frame Plans



Fusion 141 Frame Plans

Note:
Replaces Item 5 and Item 6 Drawings 82E01 and 84E02
and Items 15, 18 Drawing 80E06





A-A

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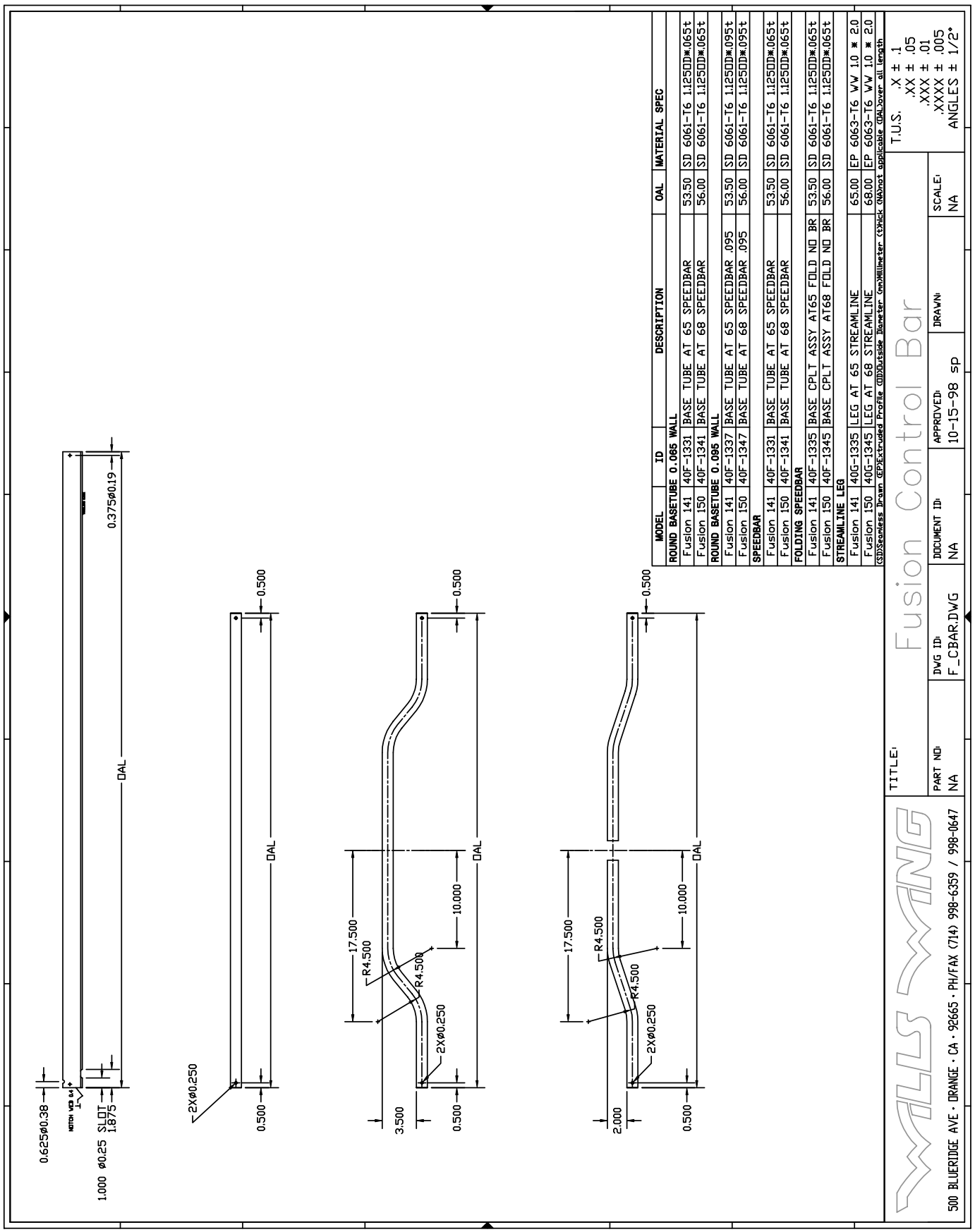
TITLE: **Button Lock Apex Slider Assembly**

Document ID:	DWG ID:	DATE:	REVISED:	BY:
na	na	06-29-98	-	Pearson



MODEL	ID	DESCRIPTION	OAL	MATERIAL SPEC
ROUND BASETUBE 0.085 WALL				
Fusion 141	40F-1331	BASE TUBE AT 65 SPEEDBAR	53.50	SD 6061-T6 1.125OD*.065t
Fusion 150	40F-1341	BASE TUBE AT 68 SPEEDBAR	56.00	SD 6061-T6 1.125OD*.065t
ROUND BASETUBE 0.095 WALL				
Fusion 141	40F-1337	BASE TUBE AT 65 SPEEDBAR .095	53.50	SD 6061-T6 1.125OD*.095t
Fusion 150	40F-1347	BASE TUBE AT 68 SPEEDBAR .095	56.00	SD 6061-T6 1.125OD*.095t
SPEEDBAR				
Fusion 141	40F-1331	BASE TUBE AT 65 SPEEDBAR	53.50	SD 6061-T6 1.125OD*.065t
Fusion 150	40F-1341	BASE TUBE AT 68 SPEEDBAR	56.00	SD 6061-T6 1.125OD*.065t
FOLDING SPEEDBAR				
Fusion 141	40F-1335	BASE CPLT ASSY AT65 FOLD NO BR	53.50	SD 6061-T6 1.125OD*.065t
Fusion 150	40F-1345	BASE CPLT ASSY AT68 FOLD NO BR	56.00	SD 6061-T6 1.125OD*.065t
STREAMLINE LEG				
Fusion 141	40G-1335	LEG AT 65 STREAMLINE	65.00	EP 6063-T6 WW 1.0 * 2.0
Fusion 150	40G-1345	LEG AT 68 STREAMLINE	68.00	EP 6063-T6 WW 1.0 * 2.0

(SD)Seamless Drawn (EP)Extruded Profile (ID)Outside Diameter (mm)Millimeter (t)Thick (NA)Not applicable (OAL)over all length

Fusion Control Bar